MONTANA COOPERATIVE ELK-LOGGING STUDY

ANNUAL PROGRESS REPORT
AUGUST, 1977

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MONTANA

COOPERATIVE ELK-LOGGING STUDY

Progress Report for the Period

January 1-December 31, 1976

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COOPERATING AGENCIES

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Bureau of Land Management
Intermountain Forest and Range Experiment Station
Montana Department of Fish & Game
School of Forestry, University of Montana

STEERING COMMITTEE

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Don McIntosh, Chairman (Apr.-Dec.)
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Robert F. Wambach

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August, 1977

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MONTANA COOPERATIVE ELK-LOGGING STUDY

January - December 1976

ABSTRACTS

JOB I

PROBLEM ANALYSIS AND COORDINATION

During the year 4 meetings involving one or more members of the research committee were necessary to plan and coordinate project activities. A total of 13 presentations were made by research committee members to advance public awareness and understanding of the elk-logging study and to convey findings to other resource and land managers. The computerized bibliography was updated and now contains 348 citations. A key word list and user's instructions are included. A number of publications were completed.

JOB II-A

BURDETTE CREEK-DEER CREEK STUDY

Procedure B-1. Pellet Count Survey

Pellet groups were counted on 305 miles of transects in late August and September. Elk use in the areas adjacent to two active timber sales declined and extremely high concentrations were recorded on the Burdette Creek winter range.

Procedures B-2, B-3a and B-3b. Elk harvest, distribution, and food habits.

The 1976 elk harvest checked at three stations was 95, just slightly lower than the eight-year average of station operation (103). Sex-age composition of the harvest was also near average. Annual variation in total harvest has been due mostly to variations in weather conditions during the hunting season. However, some changes in the distribution of the harvest occurred in response to roading and logging. The annual average elk harvest in Granite, Howard and Deer Creeks has declined 68 percent since logging operations were begun in these drainages. The importance of roadside slash disposal was demonstrated by a startled cow elk which was seen to plunge into a tangle of logs below the shoulder of a logging road. She died following the ensuing struggle.

JOB II-B

LONG TOM CREEK STUDY

The objectives of this study are to determine the enviromental requirements of elk and the effects of logging on an elk population in the scattered forest type of Long Tom Creek in Southwestern Montana. This field season (1976) was the second year of the logging phase of the study. Road construction continued through the fall with all but 3 of 14 cutting units now cut and cleared. As during previous field seasons, summer and fall elk use of the study area was determined primarily from "elk sign" recorded while periodically and systematically walking 62 miles of foot routes. Analysis of elk distribution within the study area, based on 9 distance classes from the mainline logging road, showed different seasonal responses of elk toward logging activity. The most significant response occured during the rutting season with elk use progressively diminishing toward the sale area as logging activity intensified. A correlation analysis between elk use of the study area and winter and spring precipitation measurements resulted in a highly significant ($p \leq .01$) inverse relationship ($r=-.99$) for the summer season. Correlation coefficients were not statistically significant between fall precipitation and fall elk use. There was again evidence of elk avoiding areas used by cattle during the 1976 field season. The year-long distribution of 9 radioed elk from May 1, 1974 to April 30, 1977 encompassed 208 mi^2 and ranged from 5,600 to 8,800 feet in elevation. Seasonal home ranges of individual elk were quite varied with a year-long overall average of about 1 township (36 $mi.^2$). The distance moved between successive (weekly) relocations averaged 2 air miles (year-long) and ranged from 1.4 to 2.8 miles for individual radioed elk. Fidelity of year to year seasonal distribution was greatest for the summer season and least for the spring season. There was considerable variation among standard diameter sizes of radioed elk within and between seasons. Elk use-habitat type relationships are presented and discussed with findings similar to previous years. With the progression of the study it is becoming more and more apparent that structural and juxtaposition characteristics, combined with interaction of external factors (hunting, logging, grazing, etc.,) explain variation in elk use of the area much better than step by step single variable analysis. A comprehensive analysis using the many intrinsic and extrinsic factors that occur on the Long Tom Creek summer and fall elk range is underway and will be presented in next year's progress report.

JOB II-D

CHAMBERLAIN CREEK STUDY

The first complete field season since personnel of the School of Forestry, University of Montana assumed responsibility for this study under contract to the Bureau of Land Management is reported. Nineteen-seventy-six was a very productive year for the study. All diagonal pellet transects are installed, all transect segments have been described, an initial pellet survey on all transect is complete, most initial vegetative sampling on proposed cutting units is complete

several supplemental pellet transects have been installed on proposed cutting blocks, and three elk traps have been erected on winter ranges adjacent to the study area. The 1976 data have been transferred to computer cards, and preliminary results are reported. Radiotelemetry studies were dissapointing during 1976 in that the radio-tagged elk did not use the study area. However, initial results from elk which were collared last winter indicate that telemetry sutdies during 1977 will be very productive.

ELK MANAGEMENT RECOMMENDATIONS FOR THE CONSIDERATION OF LAND MANAGERS

INTRODUCTION

The cooperative elk-logging study has concluded its 6th year and study segments are in various stages of completion.

Job I. Coordination. This is an on-going job and will continue for the life of the project.

Job II-A. Burdette Creek. Data continue to be collected in the post-logging phase.

Job II-B. Long Tom Creek. This job is just starting the logging phase.

Job II-C. Sapphire Mountains. A final report will be prepared during the next report period.

Job II-D. Chamberlain Creek. This job is just completing the pre-logging phase.

Jobs III-A-1and A-2. Judith and Ruby Road Closures. The final report is in the final editing phase.

Job III-B. Disturbed Areas. A final report will be prepared during the next report period.

Job IV. Spotted Bear. This job is completed and recommendations have been submitted to the U. S. Forest Service.

Certain findings appear to be firmly based and worthy of consideration. In order that management can benefit from the study effort prior to the final report, the research committee has been directed by the steering committee to formulate tentative management recommendations or guidelines based on findings-to-date.

It is not intended that these recommendations be broadly applied throughout the forests of Montana. Likewise, it is not intended that they be considered the "last word" or an attempt to dictate management practices to public agencies or private corporations. It is intended that they be considered a portion of the wildlife input that should be evaluated, along with many other values and inputs, in the planning of all timber sales and road construction projects. If a recommendation fits the situation, in an identified elk-use area, its implementation will help minimize any detrimental impact on the elk in the area. The recommendations merely represent an attempt by the study team to place significant findings in the hands of management as the research study progresses.

The following recommendations, although based on the best information presently available, are considered tentative and subject to change; the hazards of extrapolation must be recognized. They may not apply to certain local situations and literal application should not be substituted for detailed, joint discussions and on-the-ground inspections by timber and wildlife managers and other resource specialists.

SECURITY AREA RECOMMENDATION

Research Finding:

During active road building and logging, elk have responded by moving to surrounding ridgelines and further. The distance moved apparently depends on a variety of factors including size of the drainage area encompassed by logging, intensity and season of logging activities, and disturbance on the ridgelines.

Displacement of elk, which is considered temporary, has been detected as far as four miles from the area of summer logging activity. In one study, herd displacement was to an adjacent third order drainage and then beyond that drainage when the ridgeline was disturbed. In another investigation, displacement was down a ridgeline for two miles through undisturbed timber and over a point. In both cases, topographic features provided a line-of-sight barrier between elk and the logging activity.

Recommendation: Planning for timber sales in elk summer range should include provision of a security area immediately adjacent to the disturbed area during the active logging and/or road building period. It is also suggested that disturbances with heavy equipment on elk summer range be completed in the shortest possible time and, if possible, during periods of the year when elk are not present.

Discussion: Security for elk is still an undefined concept, but it appears that an area adequate to reduce long distance displacement of animals by timber sale activities should satisfy the following minimum criteria:

-- it must be adjacent to and easily reached by elk dispersing from the disturbed area, and the intervening ridgeline must be protected from all mechanical activities.

-- it should contain a fairly large acreage of forest cover at the head of a drainage. The particular acreage required will depend on cover quality, but the areas available to elk in one study were about 5,000 acres, and this size also approximated the average summer range (June-August) used by several radio instrumented animals in another study.

Application of the security area concept on the ground must be based on individual situations as they exist. There is no way to specify an exact acreage required for all elk everywhere.

Several available security areas are considered far superior to a single area, and where consecutive timber sales progress from one drainage to the next, it is suggested that activity be confined to a single drainage at a time with completed sales being converted to security areas as quickly as possible. While the data for predicting duration of disturbance effect (i.e. how long before the elk return to a logged area) is still incomplete, the initial indications are that total time of disturbance is more important than the severity of disturbance. Intensive activity in a single season is far less detrimental than a low level of activity over several seasons.

HABITAT TYPE-MOIST SITE RECOMMENDATION

Research Finding:

Within the various study areas, findings-to-date indicate that during the summer months (June-September) elk prefer those sites at the head of drainages bordering streams or marshy meadows, or occupying moist swales or benches. All of these sites are characterized by their close proximity to areas where water is present, on or near the surface, for all or part of the summer period. Both east and west of the Continental Divide these sites are usually found within the *Abies lasiocarpa* habitat type series. East of the Continental Divide, the dominant vegetative components of these sites are Subalpine fir, Whitebark pine, spruce, or combinations thereof. These sites are usually found within the *Abies lasiocarpa/Calamagrostis canadensis, Abies lasiocarpa (pinus albicaulis)/Vaccinium scoparium, Abies lasiocarpa/Vaccinium scoparium (Thalictrum occidentale* phase), and *Abies lasiocarpa/Luzula hitchcockii* habitat types as described by Pfister, et al. (1975). In western Montana these moist sites are generally found within the more hydric parts of the *Abies lasiocarpa/Luzula hitchcockii (menziesia* phase), *Abies lasiocarpa/Clintonia uniflora, Abies lasiocarpa/Menziesia ferruginea,* and the *Abies lasiocarpa/Galium triflorum* habitat types described by Pfister, et al. (1975).

Recommendation: Two general types of summer range situations exist in Montana. The first type occurs where moist sites are found in close proximity to each other, and in combination with other habitat components they comprise a rather large area, which is heavily used by elk. Another type of situation exists, where moist sites are not in close proximity with one another, but evenly distributed over the summer range. While this latter situation may support a large number of elk in total, each moist area may be used by relatively fewer animals. These two situations are not mutually exclusive, so both types can occur on portions of the same summer range. Where the first situation exists, an area large enough to maintain the overall integrity of the habitat components to be managed should be determined by an on-the-ground inspection by land and wildlife managers and other appropriate resource specialists. A similar recommendation to protect moist sites which are relatively far apart but evenly distributed over a summer range, as well as a security zone of cover around each site, may be impractical. However, it should be recognized that continual loss of these small units and their juxtaposition in the forest could in time have a substantial adverse impact on a local elk herd. Therefore, as many as possible of these sites should be identified and withdrawn from treatment, along with a peripheral zone to provide continuous

ROAD CLOSURE RECOMMENDATION

Research Finding:

Two phases of the project involved area closures that restricted motor vehicles to a few selected roads during the hunting season.

The Judith Road Closure Study indicated that travel restrictions did not change elk distribution or temporal distribution of hunters. Apparently this area closure was not necessary to "protect" elk where escape cover was adequate and well distributed (at least 2/3 cover to 1/3 open). Hunters spent more time walking; consequently, they reported seeing and killing more elk under the restrictions than during the unrestricted seasons. Their unsolicited comments showed a preference for limited access because of the "higher quality" hunt it afforded.

The Ruby Road Closure Study, on the other hand, showed that area closures can cause significant changes in elk distribution and hunter use of the area. This area was characterized by a relatively open, broken forest with gentle terrain and easy access (1/3 cover to 2/3 open). During seasons of restricted travel, elk stayed in the restricted area longer and in greater numbers than during preclosure seasons. This resulted in a greater season-long uniformity (but not total amounts) of hunting pressure, elk sightings, and elk harvest. Hunters also spent more time walking during the restriction period. A trend toward these same changes was noted in the unrestricted travel zone of this study area. Most hunters interviewed felt that the area closure had increased the quality of their hunt.

Recommendation: Elk management goals and objectives should be clearly defined before imposing travel restrictions, being especially cognizant of the following:

I. Restrictions will:
   1. increase the time spent walking by hunters, and as a result:
      a. increase the number of animals seen.
      b. possibly increase the kill.
   2. generally be accepted as providing a higher quality hunt.
   3. make retrieval of killed animals more difficult.

II. Where cover is good (at least 2/3 of total area) and well interspersed, restrictions will probably have little effect on elk distribution.

III. Where cover is poor (1/3 or less of total area) restrictions will:
   1. reduce harassment and emigration of elk.
   2. probably reduce the early elk harvest, but increase the uniformity of harvest throughout the season.

Discussion: Road density and pattern, including off-road travel, play an important role in determining the security level an area provides to elk during the hunting season. An area with sparse cover and low road density may provide as much security as the same sized area with heavy cover but with high road density. For example, in the Ruby portion of this study the security level was significantly increased by reducing the road density and by eliminating off-road travel. Road density and cover quality are *both* important when considering adequate elk security during the hunting season.

Also, road closures in areas that change elk distribution in space and/or time must also change elk distribution in the adjacent area(s) (an elk can't be in two places at the same time). Therefore, closures may benefit hunters in one area at the expense of hunters elsewhere.

IN REPLY REFER TO:

United States Department of the Interior

6500 M (931)

BUREAU OF LAND MANAGEMENT
222 North 32nd Street
P.O. Box 30157
Billings, Montana 59107

Information Memorandum No. MT 77-142
Expires: 12/31/78

YA-512-CT8-5

To: Director (360)
Director, DSC (D-300)
All State Directors

From: State Director, Montana

Subject: Montana Cooperative Elk-Logging Study: Progress Report and Management Recommendations

I have enclosed for your information a copy of the recent annual progress report of the Montana Elk-Logging Study. This study is a cooperative effort of the Montana Fish and Game Department, Forest Service - Region 1, Intermountain Forest and Range Experiment Station, University of Montana, and Montana BLM. We have contracted with the University of Montana to carry out the Chamberlain Creek segment of the study.

One factor that makes the study unique is that an attempt is being made to formulate management recommendations during the course of the study as soon as research findings justify such recommendations. At the conclusion of the sixth year of study, eight recommendations were agreed upon - the "Elk Management Recommendations for the Consideration of Land Managers" are found on pages xi through xix.

Direct any questions you may have on the report or recommendations to Don McIntosh, Wildlife Biologist, Montana State Office.

Edwin Dudley

Enclosure

Distribution
Director (412) 2 (w/o encl.)
Director (340) 1 (w/encl.)
Director (D-531) 3 (w/o encl.)
Directors (D-340) (D-360) 1 (w/encl.)
SD's Staff 1 (w/o encl.)
DM's, except Dickinson 1 (w/encl.)
RAH's 1

JOB I

PROBLEM ANALYSIS AND COORDINATION
PROGRESS REPORT FOR PERIOD JANUARY 1 - DECEMBER 31, 1976

INTRODUCTION

The objectives of this job are to identify the basic conflicts between timber harvest and elk ecology in the various forest types of Montana and to plan and coordinate research efforts. While these are basically unproductive activities from the viewpoint of findings, they are necessary for the smooth operation of the project and to insure that all objectives are fulfilled.

Committees

The project steering committee for 1976 included the following members:

Region I, USFS	Roger Bumstead, Chairman (Jan.-Mar.)
Bureau of Land Management	Don McIntosh, Chairman (Apr.-Dec.)
Montana Dept. of Fish & Game	Wynn G. Freeman
Intermountain Forest and Range Experiment Station	Ralph Klawitter
School of Forestry, University of Montana	Robert Wambach

The project research committee for 1976 included the following members:

Montana Dept. of Fish & Game	Eugene O. Allen, Chairman
	Reuel G. Janson
	Terry N. Lonner
Intermountain Forest and Range Experiment Station	Joe Basile
	L. Jack Lyon
Bureau of Land Management	Richard Ellison (Jan.-Aug.)
	Darrell Sall (Sept.-Dec.)
Region I, USFS	Floyd Pond
School of Forestry, University of Montana	C. Les Marcum
	Robert Ream

ACTIVITIES

During the year 4 meetings were necessary for project planning and coordination:

Date	Location	Meeting
Jan. 22, 1976	Missoula	Research Committee
April 7-8	Bozeman	Steering Committee
May 18-19	Missoula	Research Committee
July 14-15	Long Tom Creek	Steering Committee summer field trip

During the year 13 talks or programs were presented to various groups.

Date	Organization	Speaker
Jan. 21, 1976	Montana Chapter Wildlife Society, Missoula	Lonner
February 6	Arizona-New Mexico Chapter Wildlife Society, Safford, AZ	Allen
March 3	Wildlife Extension Course, Ovando	Marcum, Sall
March 15	U. S. Senate Subcommittee	Allen
April 14	Forest Service today-TV, Helena	Lyon
May 13	Bozeman Mountaineers, Bozeman	Lonner
May 20	Colorado State University Seminar, Missoula	Lyon
June 1	Yale University Seminar, Missoula	Lyon
June 6	Bitterroot Trail Riders	Marcum
June 14	Pacific Division A.A.A.S., Society of American Foresters, Missoula	Research Committee
November 8	University of Montana Seminar	Marcum
October 15	Montana Fish & Game Dept., Regional E. & I. officers	Lonner
December 9	Private Forest Land Management Symposium - Missoula	Lonner

During the 1976 report period, project personnel were responsible for 4 publications related to the overall study:

1976 Publications
Cooperative Elk-Logging Study

Allen, E. O. 1976. Statement before the subcommittee on environment, soil conservation and forestry, Senate committee on agriculture and forestry on legislation to establish National forest management policies. 8 pp.

Lonner, T. N. 1976. Elk and logging - where's the conflict? Presented at annual meeting of the Montana Chapter Wildlife Society, Missoula. 11 pp.

Research Committee 1976. Cooperative elk-logging study plan. 15 pp.

_____. Sixth annual elk-logging study progress report, January 1-December 31, 1975. 81 pp.

The 1976 summer field trip was conducted July 14 and 15 to the Long Tom Creek study area. Eleven persons were in attendance. Various portions of the study area were viewed, techniques explained and a portion of one foot route was walked.

The computerized bibliography was updated and now contains 348 citations. Following is a description of the bibliography and instructions for its use.

Submitted By: Eugene O. Allen

ELK AND LOGGING BIBLIOGRAPHY

A bibliography on elk and logging (and other land uses as well) has been compiled and adapted for use with a computerized documentation system called CH/1 (citation handler one). CH/1 was developed by personnel at the Montana State University Computing Center. The entire program and users manual are available from them. To date, 348 citations have been reviewed and condensed into 10 fields: author, title, publication, accession number (for library use only), taxon, geographic description, outline topic, abstract, parameters (if applicable, such as cow/calf ratio), and keyword index.

CH/1 contains the following 10 programs:

READ - reads a sequence of 80 (or less) character records from which it builds a file of citations.

PUNCH - converts a file of citations to the input format required by READ.

PRINT - causes all the citations in a file to be printed.

EDIT - allows the user to replace any string of characters in a specified field of some citation with another string of characters.

COPY - copies the designated citations from an existing file to form another file containing those designated citations.

MERGE - concatenates the citations from one file onto those from another file to form a third file containing the citations from both files.

SORT - orders the citations of a file so that the specified field is sorted in ascending order throughout the citations.

SEARCH - searches a file of citations in the designated field for a specified character string.

INDEX - forms an index of the terms found in the specified field.

KWINDEX - forms an index of the keywords found in the specified keyword field.

Most users of this bibliography and system would use the search and print programs involving either the outline topic field or the keyword field. Either or both of these fields can be used as an index to citations by searching the field (s) for topics and/or subtopics or for keywords as listed on the enclosed outline of topics or alphabetical list of 220 keywords.

A computer file of all citations fulfilling the search request would then be created and the program "print" would then be used to print this file for an in depth review of the citations recalled.

The entire bibliography is now on magnetic tape in two forms. One form is to be used with the CH/1 computer documentation system as explained above and the other form is for direct printing of the entire bibliography alphabetically by author. This latter form does not involve CH/1 and can be accessed directly by most computers. Both of these tapes are available for loan by calling or writing to Terry N. Lonner, Montana Department of Fish and Game, Research Section, Research Park Building, Box 5, Montana State University, Bozeman, Montana 59715. Once a user receives a loan tape the desired information should be processed as quickly as possible and the loan tape returned. For any user this procedure could be repeated each year for updating purposes. We plan on updating the bibliography every winter. If a user does not have a computing center at his disposal, an account can be established with the Montana State University Computing Center. Programmers from any computing center should be able to assist in helping the user to understand program techniques and procedures. Any discrepancy or error detected when using the bibliography and/or system, please notify Terry N. Lonner at the above address so he can make the necessary corrections on the master bibliography.

Outline Topics for Elk-logging Bibliography

General Background Material

Occurrence and original distribution of Rocky Mountain elk
History of elk in Montana
  Distribution and numbers
  Hunting and harvests
History of fire in Montana
  Effects of fire on vegetation
  Effects of fire on wildlife
History of logging in Montana
  Logging practices (past and present)
  Logging (future outlook)

Value of elk and other wildlife

Literature Review and Bibliography

Popular Articles
  Critical review
  Other

Elk (and/or other wildlife) Ecology

Seasonal range use and food habits

Seasonal cover requirements

Cover requirements during special activity periods
(rut, calving, etc.)

Relation to other land uses
  livestock
  logging
  mining } (immigration into Forests)
  people }
  hunting
  harassment

Behavior (general)

Behavior (related to forest)

Population Dynamics (related to climate)

Biology

Adaptability

Requirements of other wildlife

Nutritional requirements

The Logging Operation

Initial Activities

Physical changes
- Barriers to movements
- Changes in cover patterns
- Changes in forage
- Roads & access

Effects of logging on elk (and/or other wildlife) populations

Effects of harassment
- During initial activities
- Yearlong & after initial act

Resulting from roads & access
- Yearlong
- Hunting season (hunter behavior, pressure & harvest)
- Snowmobiles
- Other

Effects of physical change
- Range & food habits changes
- Migration & movements
- Use of altered environment
- Changes in behavior
- Changes in herd structure & size
- Changes in distribution
- General
- Use of Age & size of clearcuts & burned slash areas

Effects of logging on other wildlife

Potential effects of other land uses on elk or other wildlife

Techniques

ELK-LOGGING BIBLIOGRAPHY
KEYWORD LIST
(as of April 6, 1977)

ACCESS
AESTHETIC VALUES
AESTHETICS
AGE
ANTELOPE
ANTI-HUNTING ATTITUDES
ARTIFICIAL WINTER FEEDING
AUTECOLOGICAL CHARACTERISTICS
BEARS
BEDDING SITES
BEHAVIOR
BIBLIOGRAPHY
BIOTELEMETRY
BIRDS
BLACK-TAILED DEER
BURNING
CALF/COW RATIOS
CALVING
CATTLE

CLEARCUTS
CLEARCUTTING
CLIMATIC INFLUENCE
CLOSURES
COMPUTER SIMULATION
CONIFEROUS
CONSERVATION
COURT CASES
COVER
CRITICAL REVIEW
CUTTING CYCLE
DAILY MOVEMENTS
DECIDUOUS
DEER
DENSITY
DEPREDATION ON FOREST PLANTATIONS
DIET
DISEASES
DISTRIBUTION
DISTRIBUTION SHIFTS
DIVERSITY
DRUG INJECTION
ECONOMICS
EDGE EFFECT

EFFECTS OF HARVEST
EFFECTS OF HUNTING
ELEVATION
ELK

EMIGRATION
ENVIRONMENTALIST
EROSION
ETHICS
EUROPEAN RED DEER
EVEN-AGED STANDS
EXPOSURE
FALL RANGE
FEEDING EXPERIMENT
FERTILIZATION
FLIGHT DISTANCE
FOOD HABITS
FORAGE AVAILABILITY
FORAGE COMPETITION
FORAGE PRODUCTION
FORAGE QUALITY
FORAGE UTILIZATION
FOREST FIRE
FOREST MANAGEMENT
FOREST SERVICE
FORESTS
GAME
GAME MANAGEMENT
GENERAL ECOLOGY
GENERAL LITERATURE REVIEW
GOAT
GRAZING
HABITAT
HABITAT IMPROVEMENT
HABITAT REQUIREMENTS
HABITAT TYPES
HABITAT USE
HARASSMENT
HARVEST
HERBICIDES
HEREDITY
HISTORY
HOME RANGE
HORSES
HUMAN DISTURBANCE FACTORS
HUNTER OPINION

HUNTERS
HUNTING
HUNTING QUALITY
HUNTING SATISFACTION
INSECTS
INTERSPECIFIC COMPETITION
INTERSPERSION OF TYPES
INTRASPECIFIC COMPETITION
INVENTORY
LAND USE PLANNING

LANDSCAPING
LEARNING
LEGISLATION
LIVESTOCK
LIVESTOCK RELATIONSHIPS
LIVESTOCK-BIG GAME RELATIONSHIPS
LODGEPOLE PINE
LOGGING

MANAGEMENT
MEADOW
MECHANICAL TREATMENT
MESIC
MICROENVIRONMENT
MIGRATIONS
MINERAL LICKS
MINING
MODEL
MOISTURE
MOOSE
MORTALITY
MOUNTAIN GOATS
MOVEMENTS
MULE DEER
MULTIPLE USE
NATURAL OPENINGS
NONGAME WILDLIFE
NUTRIENT CYCLES
NUTRIENTS
NUTRITION
OUTDOOR RECREATION
OVERBROWSING
OVERSTORY
PARASITES
PELLET GROUP

PESTICIDES
PHENOLOGY
PHOTOGRAPHIC
PHYSIOLOGICAL-CLIMATIC RELATIONSHIP
PHYSIOLOGY
PLANT RESPONSE TO BROWSING AND GRAZING
PLANT SUCCESSION
POCKET GOPHER
POLLUTION
POPULAR ARTICLE
POPULAR SCRIPT
POPULATION DYNAMICS
PREDATION
PROTECTION FROM DEPREDATION
PUBLIC INVOLVEMENT
QUAIL
RANGE MANAGEMENT
REPRODUCTION
RESEARCH
RESEARCH COORDINATION
ROADS
ROCKY MOUNTAIN ELK
ROOSEVELT ELK
ROTATION INTERVAL
RUTTING
SALT
SCARIFICATION
SEASONAL HABITAT USE
SEEDING
SELECTIVE
SEX
SEX RATIOS
SHAPE
SHEEP
SHRUBS
SIGHT DISTANCE
SIZE
SLASH
SLASH REMOVAL
SLOPE
SMALL MAMMALS
SNOW DEPTH
SNOWMOBILES
SNOWPACK
SNOWSHOE HARES
SOCIAL ORGANIZATION

ELK-LOGGING BIBLIOGRAPHY - continued.

SOIL
SOIL-MOISTURE
SOLAR RADIATION
SPECIAL HUNTS
SPRING RANGE
STARVATION
STATISTICAL
STREAMS
SUMMER RANGE
TECHNIQUES
TEMPERATURE
TERRACING
TERRITORY
THINNING
THINNING TREES
TIMBER MANAGEMENT
TIMBER OVERHARVEST
TIMBER PLANTATIONS
TOPOGRAPHY
TRAMPLING
TREE REGENERATION
TREE THINNING
TREES
TULE ELK
TURBIDITY
TURKEY
UNDERSTORY
USE
VEGETATION HEIGHT
VEGETATION RESPONSE
VEGETATION TYPES
VEHICLES
WATER
WATERSHED
WHITE-TAILED DEER
WILDERNESS
WILDLIFE
WILDLIFE MANAGEMENT
WILDLIFE VALUES
WIND
WINTER RANGE
XERIC

Job II-A
Procedure B-1

CONDUCT ANNUAL PELLET COUNT SURVEYS TO DESCRIBE ELK DISTRIBUTION PATTERNS WITHIN THE BURDETTE CREEK-DEER CREEK AREA

Progress Report for the Period January 1 - December 31, 1976

INTRODUCTION

Pellet distribution surveys in Burdette Creek, Deer Creek and adjacent drainages were initiated in the fall of 1970 to (1) describe elk distribution patterns before, during and after the timber sale in Deer Creek, and (2) to describe elk use of the available environment. To date, only distribution patterns have been examined.

METHODS

A complete description of the methods used to collect pellet-count data was presented in the 1973 report. In brief, the technique involves recording pellet groups in four-foot belt transects located along the contour at 500-foot intervals throughout the study area. Transects are divided to provide information for each 40-acre block and each aspect change within a forty. In 1976, transects were surveyed between 24 August and 3 September. However, a combination of poor weather and a shortage of personnel during the survey period resulted in several transects not being completed as planned.

RESULTS

Table 1 presents a summary of pellet group data for each year since 1970. In 1976, a 10 percent increase in pellet groups per mile was recorded. The age distribution of pellet groups (table 2) suggests that the elk population on the study area has been more or less constant since about 1972.

ELK DISTRIBUTION

Table 3 presents a seven-year summary of elk distribution trends for nine subunits of the Burdette Creek-Deer Creek study area. In each subunit, the number of pellet groups per mile is expressed as a percentage of the average number of pellet groups per mile for the whole study area.

Table 1. Numbers of elk pellet groups counted by year, miles of transect and pellet groups per mile, 1970-1976.

Year	Total pellet Groups counted	Total miles of transect	Pellet Groups per mile
1970	10,830	277.2	39.1
1971	9,651	320.5	30.1
1972	7,856	324.7	24.2
1973	9,048	383.9	23.6
1974	10,126	388.3	26.1
1975	8,573	371.2	23.1
1976	7,736	304.8	25.4

Table 2. Pellet groups per mile by age class and year 1970-1976
Age Class

Year	Fresh	New	Old	Very old	Total
1970	1	9	19	10	39
1971	1	5	14	11	30
1972	0	3	10	11	24
1973	0	3	9	12	24
1974	0	2	11	13	26
1975	1	4	12	6	23
1976	0	4	13	8	25

Table 3. Elk distribution trends, pellet groups per mile as a percentage of the mean for the study area, 1970-1976

Subunit	Year 1970	1971	1972	1973	1974	1975	1976
Wall Canyon to Lion Creek	78	95	105	68	107	122	112
Deer Creek above Wall Jct.	68	56	45	34	26	32	31
Eds Creek and Gus Creek	100	80	78	112	72	62	69
Wig--Owl and upper Hyde.	90	108	82	66	74	119	110
Burdette Creek above 5000 ft.	70	92	61	101	84	70	71
Burdette Creek below 5000 ft.	168	173	210	195	215	175	246
Johns Creek and S. Fork Petty	95	76	87	100	87	82	64
Lower Hyde, Burdette, Lupine	79	73	80	55	59	91	80
Upper Lupine Creek	114	125	141	147	167	174	98
Pellets groups per mile	39	30	24	24	26	23	25
	136	99	82	77	87	77	89

The effects of winter weather on elk distribution were, as in past years, evident in these data summaries. The winter of 1975-76 started with early snows that apparently established elk distribution patterns consistent with severe conditions even though the remainder of the winter was relatively mild. There is also a suggestion that the presence of snow during the hunting season may have influenced distribution of animals. In addition, the Garden Point timber sale and a logging operation by Champion International were active in Johns Creek, there was logging activity in Lion Creek, and roads in Deer Creek were closed except for some slash cleanup and burning by Forest Service crews.

This combination of events resulted in the following changes in elk distribution:

1. Weather

   a. Early heavy snows apparently started elk movement to the winter range somewhat earlier than normal. The snow on the ground during the hunting season emphasized the particularly heavy concentration of animals in Burdette Creek -- the most inaccessible drainage on the study area.

   b. Concentration on the winter range was continued as a behavioral pattern even though the remainder of the winter was not considered severe. Wall Canyon and Wig-Owl received almost the same use as in 1974-75 which was a severe winter and Hyde-Lupine was used somewhat more than might have been expected.

   c. The decline of use in upper Lupine Creek is somewhat harder to understand since this is an important winter range. However, Lupine Creek is more accessible than Burdette Creek and is possible that hunting pressure established a pattern that was maintained throughout the winter.

2. Logging activity

   a. The two sales in the Johns Creek area depressed elk use in the Johns Creek South Fork of Petty Creek sample and may also have caused a slight rise in the upper Burdette and Eds-Gus samples.

   b. Use of Deer Creek, despite the road closure, did not increase.

   c. The decline of elk use in the Wall-Lion subunit appears minor in table 3 because winter use remained high. However, summer use declined by 50 percent because of the logging disturbance.

Plans for 1977 include continued closure of the Deer Creek drainage and continuation of the two active sales. An additional sale is being prepared in Eds Creek.

Pellet counts will be conducted in late August and early September. In addition, analysis of elk habitat selection by drainage is being initiated.

Submitted by L. Jack Lyon

JOB II-A
Procedures B-2, B-3.a and B-3.b
ELK HARVEST DISTRIBUTION AND FOOD HABITS
Progress Report for the Period
Jan. 1, 1976 - Dec. 21, 1976

INTRODUCTION

Checking stations were operated during the 1976 hunting season at three locations for the 7th consecutive year. The weather during the hunting season was unusually mild, which resulted in a relatively low harvest, and little or no movement of elk toward winter range until late December or January.

METHODS

Three checking stations were operated at the same locations and approximately the same periods as in 1970-1975. The Lolo and Fish Creek stations were operated every day during the eight-day either sex season, and on weekends thereafter. The Petty Creek station was operated only on weekends throughout the season. In addition, records from the Lolo and Frenchtown stations, operated in 1963, provided an additional year of pre-logging information.

The number of hunters and the sex, age and location of elk and deer kills were recorded. Occasional flights and ground surveys were made to document distribution, numbers and sex-age composition of the elk herd.

FINDINGS AND DISCUSSION

Hunting Pressure and Elk Harvest

The 1976 elk hunting regulations in the vicinity of the study area were similar to those of 1975, except that the either-sex season was eight days long in 1976, compared to 15 in 1975. Season dates in 1976 were Oct. 24-Oct. 31 for either sex, and through November 28 for antlered bulls.

The total number of hunters checked through the Lolo, Fish Creek and Petty Creek stations was 4100 in 1976, compared to 4565 in 1975. The total number of elk checked was 95 in 1976 compared to 102 in 1975. Although the total number checked was nearly as great as during the snowy 1975 season, the distribution of the harvest was different. In 1975, 24 elk, which comprised 24% of the elk harvest, were taken on the study area (Segment #5 in Figure 1), which has most of the winter range. In 1976, only 4 elk (4%) were taken on the study area. The difference was due chiefly to the different weather conditions during the two years. Early snow brought elk onto the winter range during the 1975 hunting season, while mild weather in 1976 caused them to stay in higher, less accessible areas.

Figure 1. Elk harvest segments in area checked by Lolo Creek, Fish Creek and Petty Creek checking stations

⊗ - Checking station location
1 - Quartz Creek-Meadow Creek
2 - North Fork Fish Creek
3 - West Fish Creek
4 - Sawmill Gulch
5 - Study Area
6 - East Petty Creek
7 - North Lolo Creek
8 - Howard Creek
9 - Granite Creek
10 - South Lolo Creek

Tables 1 and 2 show breakdowns of the checked harvest by sex-age classes and areas. Of the 95 harvested elk checked, 14 were spike bulls, 32 were branch antlered bulls, 36 were cows and 13 were calves. Harvest ratios were 44 yearling bulls per 100 older bulls, 124 bulls per 100 cows, and 36 calves per 100 cows. The net production in 1976, indicated by 36 calves per 100 cows in the harvest, was about average for this herd.

The spatial distribution of the elk harvest for each year is shown in Table 3. Prelogging information is represented by the results from checking stations run in 1963 and 1970. Although the numbers of elk harvested and their distribution have varied in response to variation in weather and hunting regulations, some changes in distribution appear to have occurred as a result of roading and logging. In 1963 two elk were reported killed in Granite Creek, 11 in Howard Creek and four in Deer Creek. Considerable logging in Granite and Howard occurred before 1970, and also since 1970. No elk were checked from Granite Creek in 1970, 1972, 1974, 1975 and 1976, and only one in 1971 and 1973. Eleven elk were checked from Howard Creek in 1970, 4 in 1971 and 1972, one in 1973, 10 in 1974, five in 1975 and four in 1976. The increased number in 1974 may have been associated with new access created by new logging roads. Deer Creek was unroaded and unlogged, except in the lower end, until 1970. Four elk were checked from there in 1963 and again in 1970. Roading began in 1970, and logging in 1971. Elk checked from Deer Creek were reduced to none in 1971, 1972, 1975 and 1976. Two were recorded in 1973 and one in 1974. The average annual harvest before logging was 17 elk in these three drainages, compared to 5.5 after logging began. This is a 68 percent reduction in elk harvest in these areas attributable to logging operations. The decline in elk harvest in Deer Creek agrees with the results of pellet group counts which show less elk use in Deer Creek since logging began (Lyon, 1976).

One marked elk, a 5-point bull, was reported killed near Martin Point October 23, 1976. There was apparently a mistake in the tagging records as they do not agree with the description of the animal shot. However, it was probably trapped and marked July 12, 1974, at Wig Creek when about 13 or 14 months old. The low return of marked animals indicates a low harvest rate for 1976, since there should have been about 17 marked elk surviving in the population from the previous year. Four of 21 marked elk were shot in 1975.

Population Trend and Herd Composition

An aerial count in the Fish Creek portion of the study area in early May was 160 elk in 1976, compared to 201 in 1975. Whether this represents fewer elk on the winter range in 1976, or merely variation due to difference in phenology or observers is not known. Previous aerial counts were 151 in April, 1971; 133 in December, 1971; 141 in April, 1973; and 150 in December, 1973. Estimates of the total number of elk in this area during the winter of 1974-75 ranged from 225 to 350 (Janson, 1976).

No field classification counts to determine the proportions of sex-age classes were made in 1976. Classifications in previous years ranged from 31 to 82 spikes per 100 older bulls, 18 to 41 bulls per 100 cows, and 30 to 53 calves per 100 cows.

Table 1. Elk harvest from Lolo, Fish and Petty Creeks by sex-age classes and locations, 1976.

Segment Number	Segment Name	Spike Bulls	B.A. Bulls	Cows	Calves	Total
#1	Quartz-Rivulet					0
#2	North Fork Fish Creek	7	16	18	7	48
#3	West Fish Creek		4	1	1	6
#4	Sawmill Gulch	5	4			9
#5	Study Area	1	3			4
#6	East Petty Creek		1	1		2
#7	North Lolo Creek		1	5	2	8
#8	Howard Creek		1	2	1	4
#9	Granite Creek					0
#10	South Lolo Creek	1	2	7	2	12
Misc:	Tank Creek			1		1
	O'Brien Creek			1		1
	Total	14	32	36	13	95

Table 2. Sex-age composition of elk harvested from the vicinity of the Burdette Creek Study Area*

Sex-age class and ratios	1963	1970	1971	1972	1973	1974	1975	1976	Ave.
					No. of Elk				
Yearling Bulls	10	18	14	6	16	14	17	14	14
Older Bulls	34	43	50	39	49	36	30	32	39
Total Bulls	44	61	64	45	65	50	47	46	53
Cows	58	54	34	23	47	30	38	36	40
Calves	19	11	10	8	16	14	17	13	14
Total Elk	121	126	108	76	128	94	102	95	106
Yrlng/100 Older Bulls	29	42	28	15	33	39	57	44	35
Bulls/100 Cows	76	113	188	196	138	167	124	124	132
Calves/100 Cows	33	20	29	35	34	47	45	36	34

* Includes reported animals not checked through the checking stations

Table 3. Distribution of harvested elk checked from the Lolo, Fish Creek and Petty Creek areas

Segment No.	Location	1963*	1970	1971**	1972	1973	1974	1975	1976
#1	Quartz-Rivulet	4	4	2	0	3	0	1	0
#2	N.Fk. Fish Creek	28	52	20	35	54	43	34	48
#3	West Fish Creek	9	7	13(+4)	5	7	4	6	6
#4	Sawmill Gul.	0	2	2(+1)	2	2	2	1	9
#5	Study Area: (Tot)	16	32	15(+19)	4	14	6	24	4
	Beaver Slough	0	0	0	0	0	0	1	0
	Wall Canyon	0	0	0	0	0	1	0	0
	Deer Creek	4	4	0(+1)	0	2	1	0	0
	Deer Peak	2	0	1	0	0	1	0	1
	Wig-Lion	0	4	1	1	2	0	1	0
	Owl-Hyde	0	3	4(+4)	0	1	0	1	0
	Burdette Creek	7	5	1(+11)	1	2	0	6	2
	Lupine-Sullivan	0	5	2(+3)	0	1	1	4	0
	Wagon Mtn. Road	1	3	0	1	1	0	2	1
	S.Fork Petty	1	7	1	0	2	1	5	0
	Garden-Johns	1	0	0	0	0	0	0	0
	Gus Creek	0	0	1	0	0	0	2	0
	Eds Creek	0	1	1	0	1	1	2	0
	W.Fk.Petty Creek	0	0	3	1	2	0	0	0
#6	E.Petty Creek	1	6	6	4	8	9	4	2
#7	N.Lolo Creek	13	2	6(+1)	11	4	5	10	8
#8	Howard Creek	11	11	4(+1)	4	1	10	5	4
#9	Granite Creek	2	0	1	0	1	0	0	0
#10	South Lolo	9	7	7	6	14	9	12	12
	Miscellaneous:(Tot)	27	2	6	5	20	8	5	2
	Tank-Corral	1	0	0	3	5	3	0	1
	O'Brien-Deep Cr.	0	0	1	2	6	1	1	1
	Misc. Fish Cr.	10	1	1	0	5	3	2	0
	Misc. Petty Cr.	14	1	0	0	4	1	2	0
	Misc. Lolo Cr.	2	0	4	0	1	0	0	0
	Totals	120	125	82(+26)	76	129	96	102	95

* Data from Frenchtown and Lolo checking stations; 1970-75 data are from Lolo Creek, Fish Creek and Petty Creek Stations

** Figures in parentheses are unchecked kills reported by Joe Bohne, U of M graduate student

Movements and Seasonal Ranges

Studies of the seasonal movements of radioed elk were completed and reported in 1975 (Janson, 1976). Some observations were made from automobile routes in Oriole, Fish and Bear Creeks in early morning during July, 1976. On July 7, two cow elk and many tracks were observed on 24 miles of route. On July 26 no elk or recent tracks were observed on the same route. This is interpreted to indicate that some seasonal movement was still occurring in early July, but it had virtually ended by late July and elk were staying under cover.

Miscellaneous Observations Supporting Management Recommendations

Recommendation: Road Location, e. right-of-way slash disposal

The importance for this recommendation was demonstrated July 7, 1976, when the writer startled a cow elk on the Bear Creek (Fish Creek) logging road, and she plunged off the road into a tangle of down logs on the lower side of the road. She managed to struggle through most of the logs but apparently tripped and fell on her side at the lower edge of the tangle with her back and head downhill and her legs caught in down logs and standing trees in such a way that she couldn't regain her feet. She died within a few moments after the writer reached her and tried unsuccessfully to extricate her.

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Janson, Reuel G. 1976. Elk harvest, distribution and food habits. Montana Cooperative elk-logging study annual progress report, September, 1976. pp. 8-14.

Lyon, L. Jack. 1976. Annual pellet count surveys to describe elk distribution patterns within the Burdette Creek-Deer Creek area. Montana Cooperative elk-logging study annual progress report, September, 1976. pp. 5-7.

Submitted by: Reuel G. Janson

JOB II-B
Long Tom Creek Study
Progress Report for the Period
January 1, 1976-December 31, 1976

INTRODUCTION

The objectives of this study are to determine the environmental requirements of elk and the effects of logging on an elk population in the scattered forest type of Long Tom Creek in Southwestern Montana. Field work has been conducted from June-November each year, 1972-1976. Findings from the 1972-74 field seasons comprise the pre-logging data base. This field season (1976) was the second year of the logging phase of the study. Road construction continued through the fall with all but the last 2 miles of the mainline road completed. The very mild and "open" fall and winter last year permitted logging to continue into March, consequently all but the 3 most northerly cutting units were cut and cleared (Fig. 1). The sale should be completed by November, 1977 with clean-up operations conducted during the summer and fall of 1978. The new road has been and will continue to be closed (with a gate) to motorized public access for at least the duration of the study.

Description of the Study Area

Long Tom Creek, located about 25 miles southwest of Butte, Montana, is a side drainage of Jerry Creek which flows southerly and empties into the Big Hole River near the village of Wise River (Fig. 2). Elevations range from 7,000 to 9,100 feet with the Continental Divide forming the north boundary of the study area. The Long Tom Creek-Upper Johnson Creek study area comprises about 36 square miles and is mostly timbered. A variety of timber and habitat types are represented, to include lodgepole pine, Douglas-fir, subalpine fir, whitebark pine, Engelmann spruce, and combinations thereof as dominant overstory species. The area is interspersed with numerous small, wet sedge meadows and bogs, parks, rocky ridges and open, south-facing sagebrush and grasscovered slopes. Clearcut logging has occurred in the head of Jerry Creek to the east and in lower Johnson Creek to the south and southwest. The only public vehicle access to the area is by 4-wheel drive from the east and northeast during periods of relatively dry road conditions. The study area is a portion of Hunting Unit 319 and is mostly on the Beaverhead National Forest with a small portion to the north located on Deerlodge National Forest land.

Methods

As during previous field seasons elk use of the study area was determined in 1976 primarily from "elk sign" recorded while periodically and systematically walking 62 miles of foot routes. During the 1976 field season the route system was walked 5 times between June 22 and October 2.

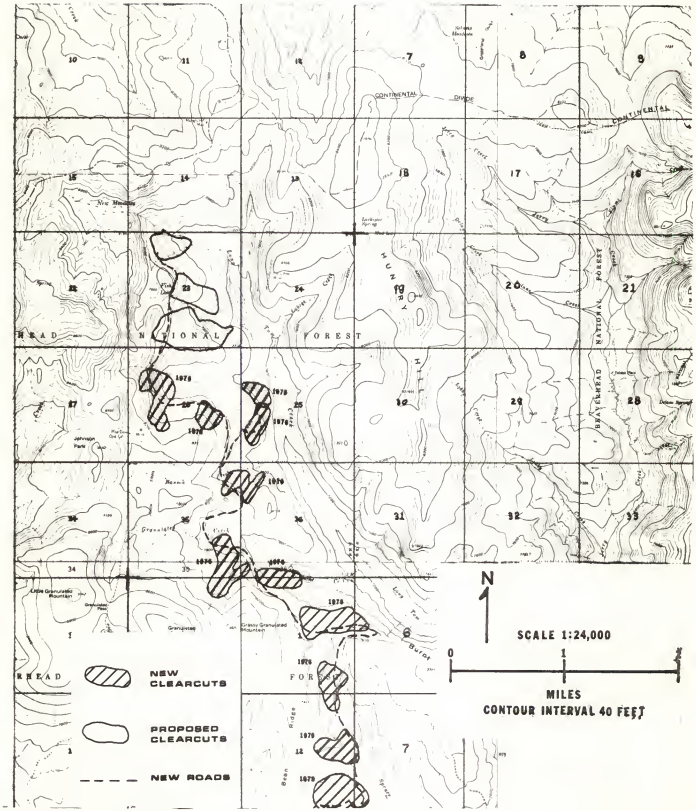


Figure 1. Completion status of the Long Tom Creek timber sale as of June, 1977.

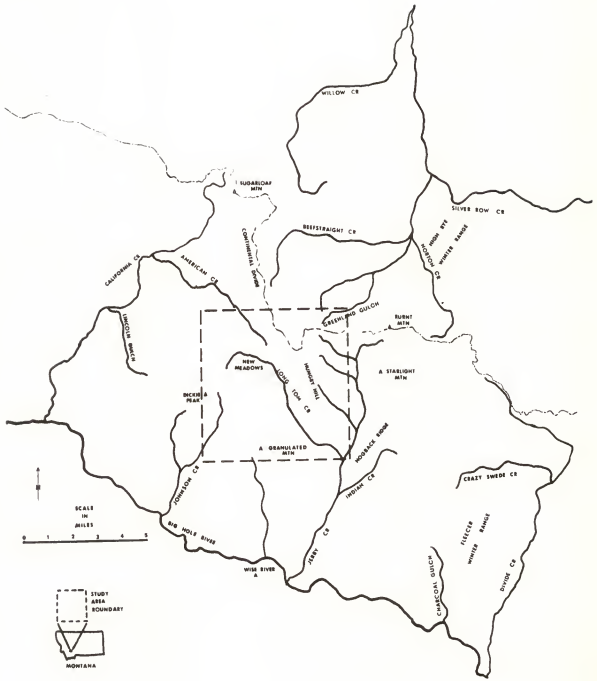


Figure 2. Vicinity of the Long Tom Creek Study area.

The eleven foot routes were established in 1972 with minor revisions made in 1973. They range from approximately 3.0 to 9.0 miles in length and average 5.6 miles. Each route has been divided into segments with each segment representing a single general cover type; park, broken park, timber, or clearcut. A detailed explanation of the route system and how elk use is recorded while walking the routes is presented in last year's progress report (Lonner, 1976). Measurements recorded along the route system and their completion status are presented in Table 1.

In previous reports elk distribution was described by 16 subdivisions of the study area. Although these subdivisions were made based on the general homogeneity of each area and the layout of the route system, a large amount of seasonal and year-to-year variation of elk use occurred within and between these subdivided areas. This variation was largely attributable to the mobility of the elk coupled with the subdivided area sizes being too small and subsequently much too sensitive to elk movements. On the other hand this method proved not sensitive enough to detect any distributional shift of the elk that might have occurred because of the logging operation. Elk may have changed their distribution within any subdivided area due to the logging activity without leaving that area or influencing the distribution in other areas. Because of these problems another approach was taken to describe elk use and distributional shifts within the study area. The nearest distance (in air miles) from the new mainline logging road to each segment of the route system was measured using aerial photos. Each measurement was then placed in 1 of 9 distance classes from the new road: 0-.05, .06-.1, .11-.25, .26-.50, .51-.75, .76-1.0, 1.01-1.5, 1.6-2.0, and 2.01+ miles. These measurements were made ignoring the degree and progress of road construction and/or logging activity.

Since the mainline logging road is on or very close to all cutting units of the sale, these distance classes, as they get further from the road, should generally represent a diminishing influence of the logging activity on the elk. These distance classes will not provide a good definitive measurement of elk use of the area but should partially reflect any significant influence the logging activity has had on elk distribution. The road distance classes and the area each one represents are presented in Figure 3.

Radio telemetry was again used to gather detailed information on a few individual elk. All transmitters were put on using a helicopter and capture gun. Eight cow elk and one bull were tracked on a weekly interval from May 1 to December 1 primarily from a light plane and provided information on movements and distribution. Intentional disturbances of certain radioed elk was done in an attempt to study disturbance-movement response relationships. This will be continued during the 1977 field season and reported in next year's progress report.

Hunter questionnaires were filled out on opening day of the general big game season at 6 check stations located near the Long Tom Creek study area. Similar surveys were conducted in 1972, 1973, 1974 and 1975 and will be continued throughout the study.

Table 1. List of 28 measurements for each of the 700 segments composing the 62 mile foot route system in the Long Tom Creek study area.

Elk use (pellet groups and general impression)[1]
Deer use (pellet groups, observations, tracks)[1]
Cattle use (droppings per pace, observations, tracks)[1]
Forage use[1]
Wetness type[1]
Wetness degree[1]
Segment length[2]
Cover type[2]
Habitat type[2]
Dominant and sub-dominant tree species[2]
Average tree height[2]
Density of mature trees[2]
Density of regeneration[2]
dbh averages[2]
Canopy coverage[2]
Tree stand age[3]
Distance to closest cutting unit and/or road[2]
Sight distance[2]
Downfall[2]
Ground cover or understory vegetation (largely explained by habitat type)[2]
Aspect[2]
Configuration[2]
Topography[2]
Slope (%)[2]
Size of opening (park, broken park, clearcut) segment passes through (if applicable)[2]
Indices of interspersion, diversity, and homogeneity for each of the 4 general cover types and combinations thereof.[2]

[1]Measured each time segment is surveyed (all others only measured once).
[2]Measurements are completed.
[3]Measurements are 40 percent complete.

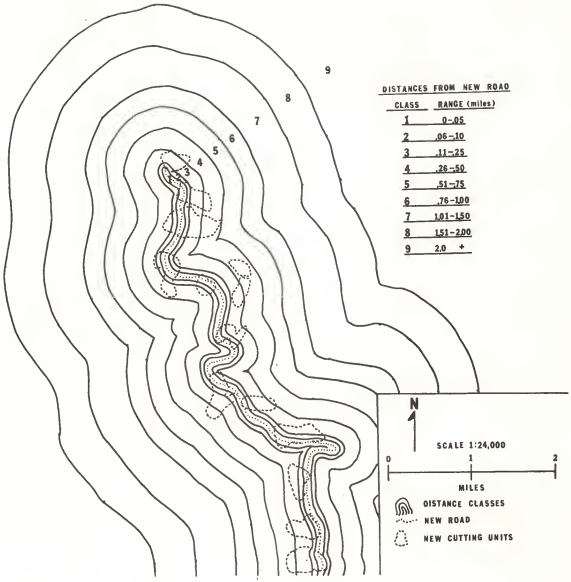


Figure 3. Road distance classes as related to the Long Tom Creek timber sale and mainline logging road.

Time lapse photography was again used in the study area and involved three 8 mm movie cameras. The cameras were used in a natural opening, a cut-through park within a large clearcut, and overlooking the study area to record progress of timber removal.

As in 1974 and 1975, elk use adjacent to the proposed or new logging road was measured by 27 six foot wide belt transects. Most of these transects were established in 1974 or 1975 and are approximately 1/4 mile apart, extending 200 yards (paces) on each side and perpendicular to the road. This sampling system primarily records fall use (actual pellet groups) made by elk during the previous fall(s). These transects will continue to be walked once toward the end of the summer each year for the duration of the study.

Increment borings of various tree species and sizes along the route system was begun and approximately 40 percent completed last field season. An attempt to finish these measurements will be made during the 1977 field season. The core samples obtained, after aging all trees sampled, will serve as indices to stand ages and will then be correlated with several other vegetational and physiographical measurements previously made of the route system.

Thus far, most elk use relationships have been analyzed from recordings and measurements made directly on the route system from the ground. Last winter we completed measuring the general composition of the area surrounding each segment of the route system by an aerial photo interpretation technique. This technique involved plotting the segments of the route system on aerial photos as accurately as possible. A gridded transparency was then placed over the middle of each segment and oriented to north. The grid area was 148 acres divided into 1 square acre plots, and was roughly circular in shape. Each plot was then assigned a code representing 1 of 16 general cover types or combination of general cover types. The general cover types used as a basis were timber (100+ trees/acre), broken park (26-100 trees/acre), park (25 trees or less/acre), clearcut (any cutover area regardless of age), and rockslide. Rockslide was very minor and to keep cover type combinations as small as possible was only counted if it made up 50 percent or more of a square; otherwise the plot was marked by the other cover types present. If Rockslide did make up more than 50 percent of the plot, then it was marked as only rockslide. Any one of the other 4 general cover types was counted only if it occupied at least 10 percent of the plot. This resulted in 16 possible combinations and were assigned numerical codes as follows: 1 - timber; 2 - park; 3 broken park; 4 - clearcut; 5 - rockslide; 6 - timber, park; 7 - timber, broken park; 8 - timber, clearcut; 9 - park, broken park; 10 - park, clearcut; 11 - broken park, clearcut; 12 - timber, broken park, park; 13 - timber, park, clearcut; 14 - timber, broken park, clearcut; 15 - park, broken park, clearcut; and 16 - timber, park, broken park, clearcut.

After all the plots within each 148 acre area were coded, the data were computer filed. A computer program was written to scan the file by segment and measure the general composition of the 148 acre area using the 16 coded cover types. This resulted in a delineation of cover types into "type expressions" by grouping all like numerical codes that were adjacent

to one another. When 2 like codes met diagonally this was not counted as being adjacent. To best explain this, a computer picture of an area scanned is presented in Figure 4. In this example there are 9 general types and 48 type expressions. The computer then tabulated for each of the 16 general types the number of expressions, total area in acres and percent of the total 148 acres, minimum expression size, maximum expression size, and average expression size for each of the 700 segments. From these tabulations the total amounts (in acres and percentages) of timber, park, broken park, and clearcut were calculated for each 148 acre area and extrapolations made for the study area as a whole. Preliminary indices describing diversity, interspersion, and juxtaposition of the various cover type combinations have also been calculated for each 148 acre area around each segment.

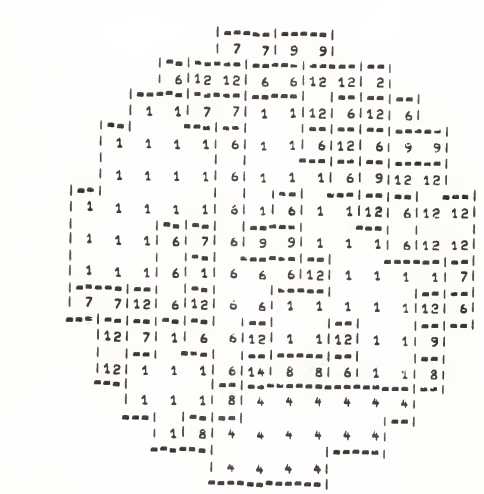


Figure 4. An example from a computer scan of one segment of the route system to help determine elk use-juxtaposition relationships. In this example there are 48 type expressions; 4 timber, 1 park, 1 clearcut, 13 timber-park, 6 timber-broken park, 4 timber clearcut, 5 park-broken park, 13 timber park-broken park, and 1 timber-broken park-clearcut.

These measurements and calculations, together with all of the ground work that has been done, should give us a more complete understanding of the ecological relationships of elk while on summer and fall range. Analysis using this information has just begun and will continue after the 1977 field season.

Findings and Discussion

Elk Distribution and Movements

Analyses of elk distribution within the study area, based on the 9 distance classes surrounding the mainline logging road, showed different seasonal responses of elk toward logging activity. Elk use tended to increase as the distance from the new road increased during the summer season all years. Although there was some variation of elk use within distance classes between years, correlation coefficients between elk use and the distance from the new road were all positive and ranged from .62 in 1975 to .77 in 1973 and 1974 (Fig. 5). Since the route system was only walked once in the summer of 1972 during the latter half of August, the data were more representative of elk distribution for the rutting season and were not used in the analysis. Some road clearing occurred during the summer of 1974 and road construction and logging occurred during the summer of 1975, but in both years this activity was on the southern extreme of the study area. It is important to realize that the overall summer elk distribution has not changed significantly from the summer of 1973 to 1976 which was a year of intense roadbuilding with some logging in the center of the study area. From these data it is apparent that there was a natural aversion toward the sale area during the summer season before any logging activity began and that logging activity thus far has not significantly influenced the little use that occurred previously. Conversely, during the rutting season, elk use changed significantly within and between the road distance classes with the progression of logging activity from 1972 to 1976. Correlation coefficient calculations of elk use with distance from the timber sale have increased steadily from -.43 in 1972 to .77 in 1976 (Fig. 6). This demonstrates that the sale area was used heavily by elk during the rut before any logging activity started with elk use progressively diminishing toward the sale area as logging activity intensified. The distribution of elk use within the study area for the entire fall season showed little correlation between elk use and road distance within years and there was no apparent year-to-year trend of correlation coefficients one way or another (Fig. 7). If any significant aversion of the elk toward fall logging activity was to occur, it should have begun during the fall in 1976 (fall use during 1976 will not be measured until the 1977 field season when pellet groups dropped during previous fall(s) will be recorded). This may be especially true since the 1976 fall and 1976-77 early winter were mild and "open" with very little snow accumulation, therefore logging and elk use of the area were inhibited little by deep snows.

Overall summer elk use of the study area has fluctuated since 1973 and elk use of the study area has progressively declined during the rut

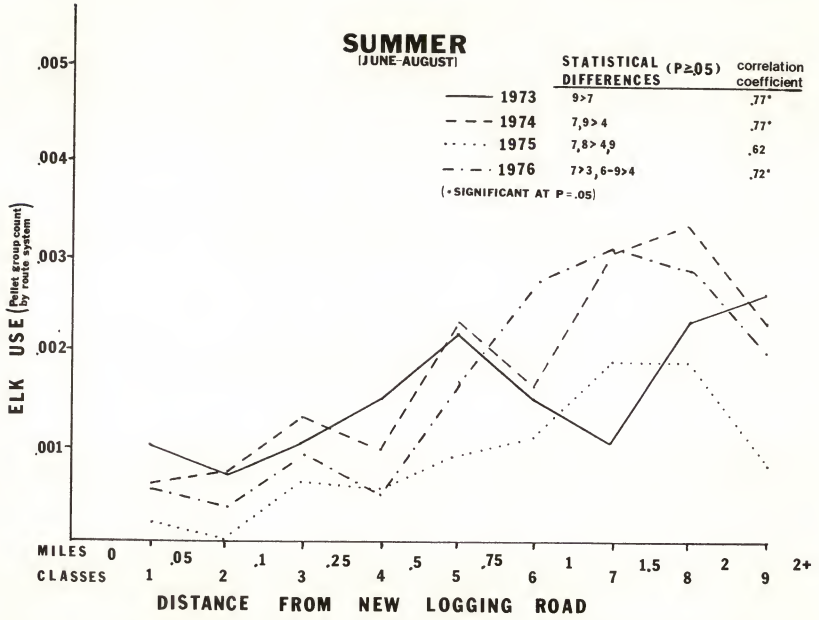


Figure 5. Elk use comparisons between road distance classes for the summer season, 1973-1976.

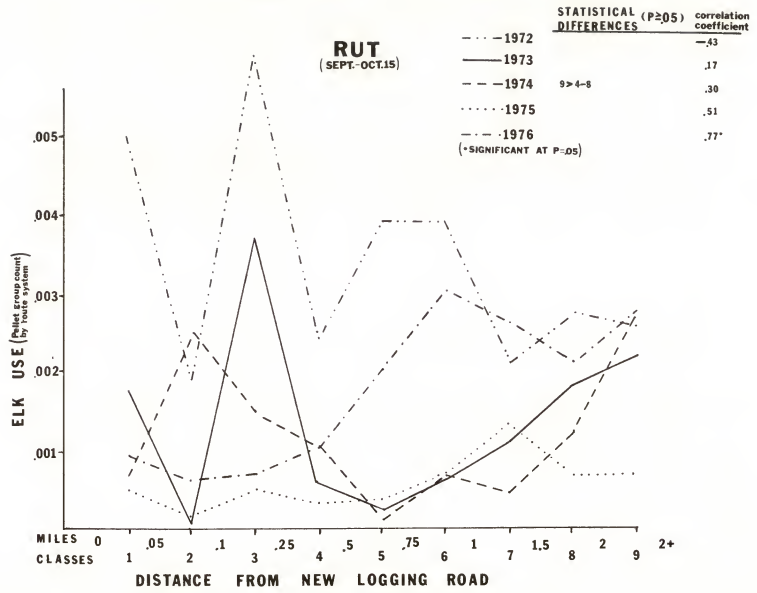


Figure 6. Elk use comparisons between road distance classes for the rutting season, 1972-1976.

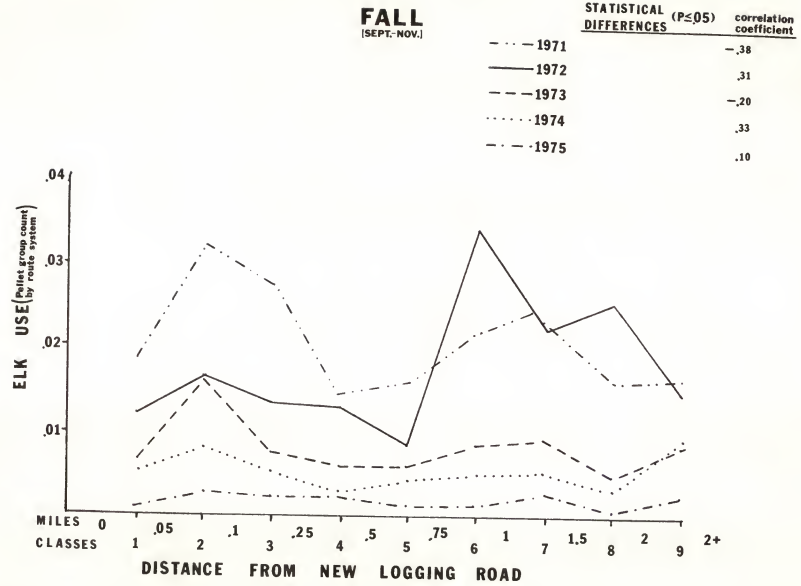


Figure 7. Elk use comparisons between road distance classes for the entire fall season, 1971-1975.

from 1972 through 1975. Measurements of elk use during the rut in 1976 ended this trend with use this year measuring the second highest it has been since field work began in 1972. Trends in elk use between the rut and all fall seasons were remarkably similar (Fig. 8). The data suggests that elk use of the study area during the rut and most likely late summer strongly dictates the level of use throughout the fall months. This is logical, although I didn't expect such a strong relationship because of year to year fall climatic differences (snow accumulation differences) and influences. Apparently, elk that were in the study area during the rut and late summer stayed there most of the fall, and fall snowstorm activity had little influence on fall elk use of the study area.

A correlation analysis was done between elk use of the study area and precipitation measurements (total inches of precipitation recorded at a weather station about 4 miles SW of the area). This was done for the summer, rut, and all fall seasons with precipitation measurements used from the months that would most likely influence elk use of the area during a given season. Results of this analysis are presented in Figure 9. Correlation coefficients were not significant for the rut and all fall seasons, but highly significant (P - .01) for the summer season. This indicates that winter and spring snow fall strongly influenced when and how many elk arrived in the study area and, consequently, the length of stay and level of elk use recorded during the spring and summer months. During years with a long winter and/or a late spring the level of elk use in the study area may also be influenced strongly by phenological conditions. That is, elk may remain more dispersed throughout the area surrounding the study area because of the delayed and prolonged greenup of important forage species. Precipitation amounts apparently had little influence on elk use of the study area during the rut. Although not statistically significant, the correlation coefficient for the fall months in general showed an inverse relationship between elk use and precipitation, especially when the precipitation was high. These results merely substantiate, with some qualifications, the known general relationship between elk distribution and snow-storm activity.

Elk-Cattle Interaction

As described in previous progress reports (Lonner 1975 and 1976), there was again evidence of elk avoiding areas used by cattle during the 1976 field season. This occurred even though cattle use of the study area in 1976 was the lowest recorded since the study began (Fig. 10). All but one of the coefficient of association values calculated from 1976 data resulted in a negative value. Segments with little or no forage use, as in previous years, accounted for most of the elk use throughout the summer and fall. For a detailed explanation and a more complete discussion of elk-cattle relationships see last year's progress report (Lonner 1976).

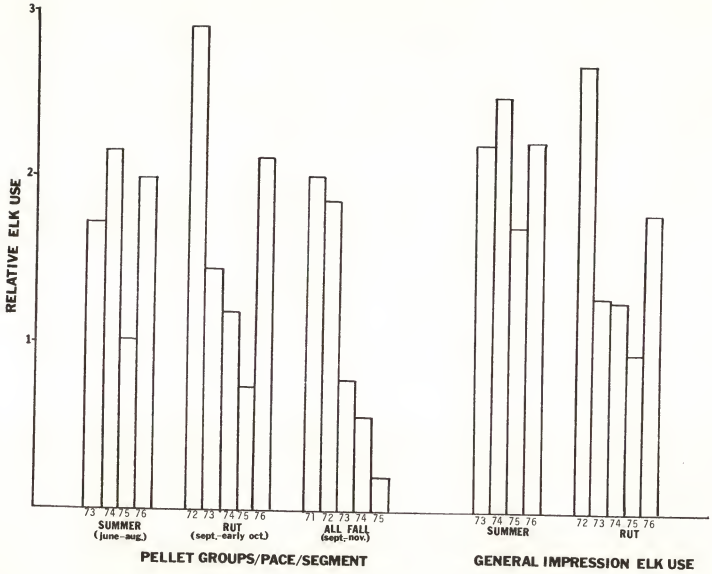


Figure 8. Year to year elk use intensity comparisons of the study area by season and elk use recording method.

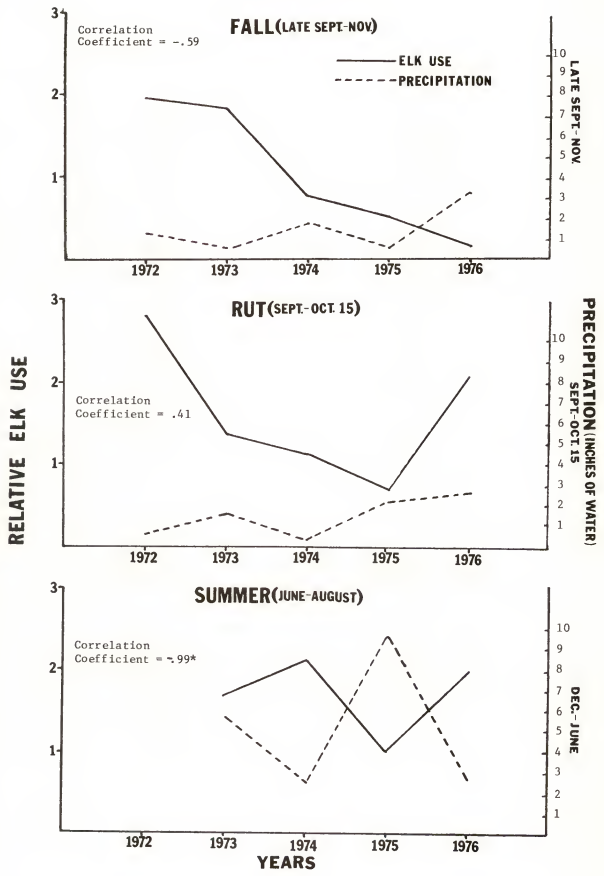


Figure 9. Correlations between elk use of the study area and precipitation measurements (* = significant ≤ .01)

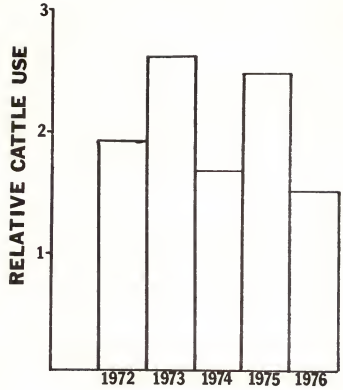


Figure 10. Overall cattle use (droppings recorded by route system) of the study area compared between years, 1972-1976.

Home Ranges and Movements

Radio telemetry has been used to give us a general idea of seasonal and yearly movement and distribution patterns of radio-collared elk. During the 1976 field season 9 elk were radio-tracked. One of these has been working since April, 1974, while 6 have been working since spring, 1975 and two more radioes were put on during the spring of 1976 (one was captured as a 2-year-old bull and the other a 1-year-old-cow). All of these elk survived the 1976 hunting season. The interval between relocations was approximately 7 days from May 1 to December 31, 1976. During the winter months (Jan. 1-Apr. 30) relocations were made about every 3 weeks. Most relocations were made from a fixed-wing aircraft.

Thus far, data collected from tracking these few elk (1-2 percent of the entire elk herd in management unit 319) has given us much insight into weekly, seasonal, and yearly movements. Without the use of radio telemetry,

acquiring this kind of information in a moderate to heavily forested area, such as in and around the Long Tom Creek study area, would have been impossible. Even when we knew where the radioed elk were located we only saw them an average of 37 and 20 percent of the time in 1975 and 1976, respectively (Table 2).

The yearlong distribution of these elk from May 1, 1974 to April 30, 1977 encompassed 208 mi^2 and ranged from 5,600 to 8,800 feet elevation (based on 607 radio fixes). The average distance moved between any 2 successive relocations for any season ranged from .3 miles (by channel 8 during the spring of 1975) to 5.1 miles (by channel 1 during the hunting season in 1976) and averaged 2.0 and 2.1 miles yearlong (May 1-April 30) in 1975 and 1976, respectively. Seasonal home ranges were quite varied ranging from near 0 to 32.7 square miles with a year-long overall average of about 1 township (35.5 square miles in 1975 and 38.1 square miles in 1976) (Table 3). It is interesting to note that during the rut in 1976 channel 4, a 2½-year-old-bull, had an average weekly movement of 4.6 miles while 8 cow elk with radioes averaged only 1.8 miles between weekly locations during this time.

Seasonal areas of distribution were described with the standard diameter method, where 1 standard diameter is the diameter of a circle which has the geographic activity center as its center with presumably at least 68 percent of the animal's activity occurring in that circle (Harrison, 1958). This method also provided an index of home range size and extent of movement.

Year to year seasonal distribution of elk varied mostly during the spring and winter seasons, which was primarily due to large differences in weather conditions between 1975 and 1976. Between 1974 and 1976, two years with similar spring weather conditions, channel 2 spent the spring months near the same location (Fig. 11). The average distance between individual geographic activity centers for these two seasons between 1975 and 1976 was 6.3 miles and 2.2 miles, respectively. The spring in 1975 was a continuation of the winter with good spring breakup not occurring until mid-June; consequently, the elk stayed mostly on or near their winter ranges until mid-late June and apparently calved there. On the other hand, the open and mild winter of 1976-77 allowed the elk to remain on or near their summer and/or fall ranges much longer than during the winter of 1975-76. Differences between yearly activity centers for these two seasons are presented in Figures 11 and 15. These differences are also reflected by elevational data (Table 2). The average elevation where the elk were found during the spring of 1975 and 1976 was 6,300 and 6,900 feet, respectively, and during the winter months of 1975-76 and 1976-77 the elevations averaged 6,400 and 6,900, respectively. The most fidelity of year to year seasonal movement occurred for the summer season - .86 mile average between geographic activity centers of like radio channels; next was the rut - 1.04 average mile between geographic activity centers; and third was the hunting season - 2.0 mile average between geographic activity centers (Figures 12-14).

Table 2. Minimum, maximum, and mean elevation of relocations and percent time observed for 10 radio-equipped elk tracked 1 May - 30 April during 1974, 1975 and 1976.

Radioed Elk			Season and Yearlong Relocations																					
			Spring				Summer				Rut				Hunting				Winter				Yearlong			
			May 1-June 15				June 16-Aug. 31				Sept. 1-Oct. 15				Oct. 16-Dec. 5				Dec. 6-Apr. 30				May 1-Apr. 30			
Ch. No.	Sex	Age[2]	Min	Max	$\bar{X}$	% Obs	Min	Max	$\bar{X}$	% Obs	Min	Max	$\bar{X}$	% Obs	Min	Max	$\bar{X}$	% Obs	Min	Max	$\bar{X}$	% Obs	Min	Max	$\bar{X}$	% Obs
175	F	5½	56[1]	63	60	40	65	80	73	71	60	76	69	0	66	78	71	75	56	61	59	50	56	80	67	44
175			66	70	67	0	64	78	74	18	62	80	70	0	64	80	73	14	62	70	66	56	62	80	70	21
274	F	Ad	65	74	70	40	76	83	81	71	74	78	76	50	–	–	–	–	–	–	–	–	65	83	76	53
274			60	66	64	40	68	82	77	64	71	84	79	33	65	72	70	50	64	73	68	80	60	84	73	54
274			66	77	71	17	74	83	80	33	70	81	74	33	72	82	77	0	64	79	72	33	64	83	76	26
376	F	Calf	63	76	71	43	66	82	74	25	66	72	69	0	63	78	70	29	61	78	67	22	61	82	70	24
476	M	1½	62	80	73	14	74	88	80	8	74	88	78	0	73	80	76	29	64	88	75	11	62	88	77	12
575	F	Ad	58	69	61	25	65	86	78	57	64	86	79	0	69	77	73	50	58	66	63	100	58	86	72	43
575			62	68	65	17	65	86	79	25	65	82	74	0	63	85	77	29	60	80	66	11	60	86	73	18
675	F	1½	62	68	65	60	64	83	73	22	70	82	75	22	65	75	71	25	64	73	68	80	62	83	71	38
675			64	75	69	17	70	86	79	18	67	76	71	0	72	80	76	0	64	78	73	11	64	86	74	10
875	F	Ad	57	67	61	0	58	76	69	22	56	70	65	0	66	68	68	0	59	63	61	100	56	76	65	24
875			58	72	67	67	57	78	71	9	56	68	60	33	58	76	66	14	62	72	67	20	56	78	67	26
975	F	1½	58	67	61	0	56	71	65	40	56	67	61	11	62	71	65	0	59	64	62	67	56	71	63	26
975			56	64	61	0	64	72	67	36	59	68	63	0	56	68	62	14	56	72	62	22	56	72	63	18
1175	F	Ad	65	68	66	20	70	82	77	54	72	82	78	22	72	84	78	25	62	73	67	83	62	84	74	43
1175			66	75	73	83	74	83	80	21	70	77	74	0	70	79	75	0	64	82	72	22	64	83	76	24
1275	F	Calf	62	70	67	25	71	79	75	22	66	80	74	22	Last located on 10/24/75								62	80	73	23
1975-76		Totals	56	70	63	26	56	84	73	43	56	87	73	15	62	84	71	32	56	73	64	82	56	87	70	37
1976-77		Totals	56	80	69	29	57	88	76	22	56	88	70	7	56	85	73	14	56	88	69	23	56	88	72	20

[1]Elevation statistics are in hundreds of feet.
[2]Age at capture.

Table 3. General statistics on 10 elk that were radio-equipped and tracked from 1 May-30 April during 1975 and 1976.

Radioed Elk			Winter Range where Captured	Locations and Distances (Aerial Miles) Season and Yearlong Relocations																						Max. Distance Between Any 2 Locations
				Spring May 1 - June 15				Summer June 16-Aug. 31				Rut Sept. 1-Oct. 15				Hunting Oct. 16-Dec. 5				Winter Dec. 6-Apr. 30				Yearlong May 1-Apr. 30,			
Ch[1] No.	Sex	Age[2]		No.[3]	$\bar{X}$[4]	Area[5]	Max[6]	No.	$\bar{X}$	Area	Max	No.	$\bar{X}$	Area	Max	No.	$\bar{X}$	Area	Max	No.	$\bar{X}$	Area	Max	No.	$\bar{X}$	Area	Max	
175	F	5½	High-Rye	5	2.2	8.5	4.5	7	3.1	22.6	4.9	7	1.9	5.6	3.9	4	2.3	3.0	2.7	4	1.9	1.7	2.7	28	2.8	63.6	9.1	14.0
175				6	2.3	4.3	5.5	11	1.6	14.9	5.1	6	1.3	2.9	2.8	7	5.1	28.0	7.4	9	3.2	13.6	8.7	39	2.5	57.9	8.7	11.0
274[8]	F	Ad	Fleecer	5	2.9	10.1	5.2	7	.7	.9	1.0	-	-	-	-[7]	-	-	-	-	-	-	-	-	19	1.5	28.1	5.2	11.2
274				5	2.9	11.8	5.9	14	1.5	8.1	3.0	9	2.5	11.6	4.4	4	1.4	1.5	2.1	5	1.0	.8	1.3	37	2.0	35.1	5.9	11.3
274				6	2.6	13.0	5.7	15	.9	2.3	2.4	6	2.3	3.6	4.3	7	1.7	4.1	3.3	9	2.7	16.2	6.1	43	1.8	30.1	6.1	10.3
376	F	Calf	Fleecer	7	2.4	19.9	6.0	12	2.6	23.2	6.7	6	1.9	1.4	3.7	7	2.8	10.0	5.0	9	1.4	6.1	4.8	41	2.2	44.9	6.7	10.5
476	M	1½	Fleecer	7	3.1	11.6	7.1	13	2.7	12.6	9.6	6	4.6	4.6	6.8	7	2.9	7.0	7.6	9	1.4	2.9	2.1	42	2.7	27.6	9.6	10.0
575	F	Ad	High-Rye	4	.8	.6	1.1	7	2.4	13.4	5.7	9	1.0	4.2	4.1	4	3.9	6.5	5.1	6	2.1	3.6	3.7	31	2.5	52.7	10.0	16.2
575				6	4.2	27.0	14.2	12	1.5	9.7	3.1	6	2.0	5.8	3.3	7	3.7	19.6	7.4	9	3.8	32.7	11.3	40	2.7	74.7	14.2	14.5
675	F	1½	Fleecer	5	1.9	.7	3.5	9	2.0	6.9	3.9	9	.8	1.5	1.1	4	3.5	5.9	5.7	5	1.1	1.1	1.8	32	2.0	22.0	7.3	8.8
675				6	1.3	4.4	3.7	11	1.2	4.3	2.7	6	1.0	1.0	2.3	7	1.1	2.7	3.0	9	1.7	8.4	5.5	39	1.4	15.7	5.5	6.0
875	F	Ad	High-Rye	6	.3	0	1.6	9	2.0	11.4	5.1	9	.9	2.7	2.4	4	1.4	.3	2.5	6	1.5	4.6	2.5	35	1.4	27.5	5.6	8.5
875				6	2.9	15.2	4.6	11	1.7	11.7	3.2	6	1.5	2.5	2.5	7	2.9	13.3	5.6	5	2.1	5.2	4.1	35	2.1	38.9	5.6	9.0
975	F	1½	High-Rye	5	1.8	2.6	2.7	10	2.1	7.6	3.5	9	1.5	5.1	3.0	4	.5	.1	.7	6	1.6	5.4	2.5	35	2.0	31.1	8.1	12
975				6	1.1	1.9	1.6	11	1.2	4.9	4.0	6	2.2	3.4	3.2	7	2.0	7.9	2.8	9	2.4	12.4	4.4	39	1.7	22.4	4.4	9.3
1175	F	Ad	Fleecer	5	1.6	1.3	3.6	13	1.8	10.4	3.5	9	2.1	7.3	4.7	4	4.3	.2	5.5	6	1.3	1.8	2.5	38	2.3	30.7	7.5	11.5
1175				6	2.8	14.2	5.5	14	.8	2.1	2.4	6	1.9	3.2	3.8	7	1.6	4.4	2.7	9	2.4	12.2	7.9	42	1.7	30.5	7.9	10.3
1275	F	Calf	Fleecer	3	1.8	.6	2.0	9	1.7	3.7	4.1	9	1.1	5.5	3.2	Last located on 10/24/75								21	1.4	21.2	4.1	7
1975-76 Averages				5	1.6	3.3	3.0	10	1.9	10.5	4.2	9	1.4	5.4	3.4	4	2.7	2.9	3.5	5.4	1.5	2.7	2.4	32	2.0	35.5	7.2	11.2
1976-77 Averages				6	2.5	12.4	6.0	12	1.6	9.5	4.4	6	2.1	3.2	3.6	7	2.6	10.8	5.0	9	2.4	12.2	6.1	40	2.1	38.1	7.6	10.1

[1]First digit is channel number and other 2 are the year collared.
[2]Age at capture.
[3]Number of relocations.
[4]Average distance moved between successive locations.
[5]Area in square miles based on connecting perimeter locations to form a polygon.
[6]Maximum distance moved between two successive locations.
[7]Data insufficient for calculation (none or less than 3 locations).
[8]These data for spring, 1974 through winter 1975.

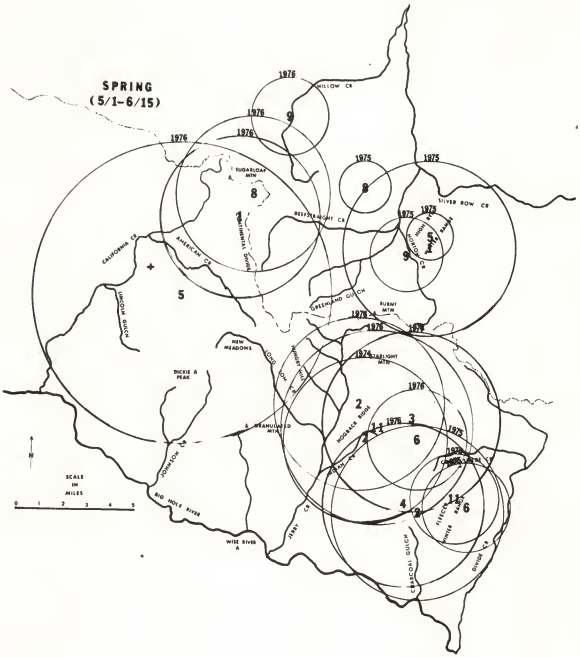


Figure 11. Standard diameters and geographic activity centers of 9 radio-equipped elk in or near the Long Tom Creek study area compared between years for the spring season.

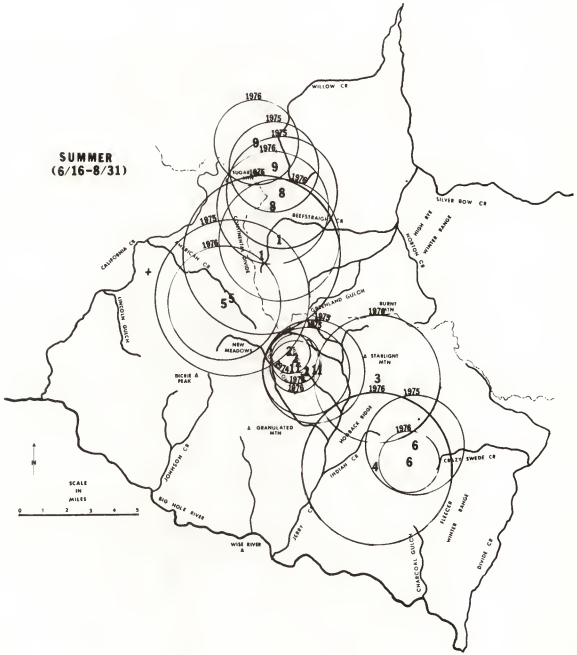


Figure 12. Standard diameters and geographic activity centers of 9 radio-equipped elk in or near the Long Tom Creek study area compared between years for the summer season.

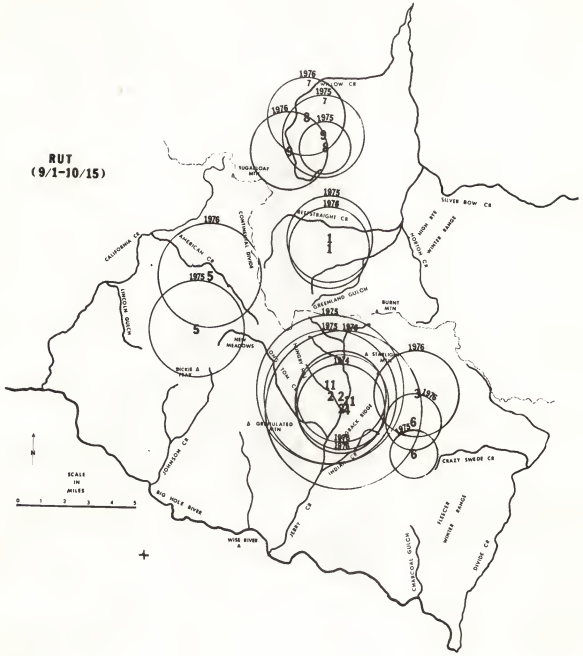
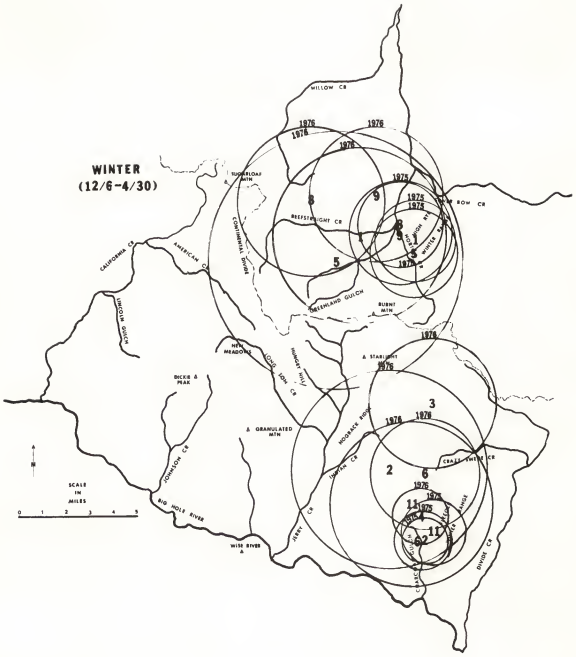


Figure 13. Standard diameters and geographic activity centers of 9 radio-equipped elk in or near the Long Tom study area compared between years for the rutting season.

Figure 14. Standard diameters and geographic activity centers of 9 radio-equipped elk in or near the Long Tom study area compared between years for the hunting season.

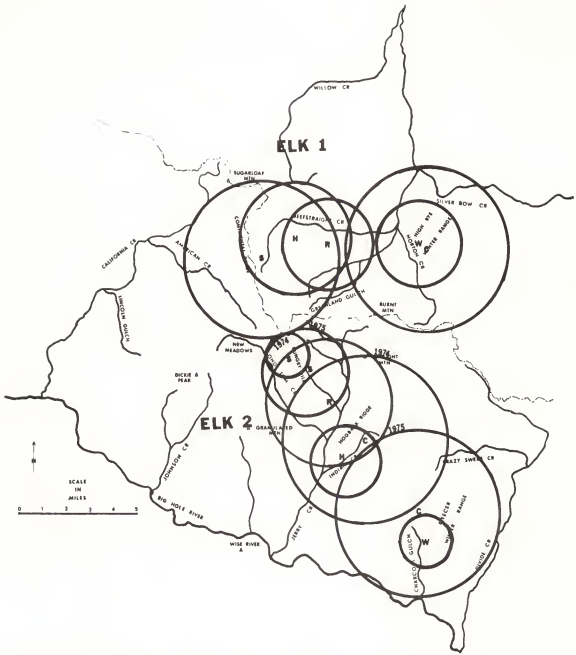

WINTER
(12/6-4/30)
WILLOW CR
1976
1978
1976
1978
1976
1978
1978
1978

There was considerable variation among standard diameter sizes within and between seasons as illustrated in Figures 11-23, especially between elk. Regardless of this variation between seasonal ranges and in movements, there was a strong tendency for each radioed elk to use the same general area year to year (Figs. 16-23). As noted earlier, some of this variation was most likely due to weather influences, but most was apparently due to individual differences in traditional range use and movement patterns. Simply put, some elk are 'home bodies' while others are 'traveling salesmen' (Fig. 19).

Habitat Relationships

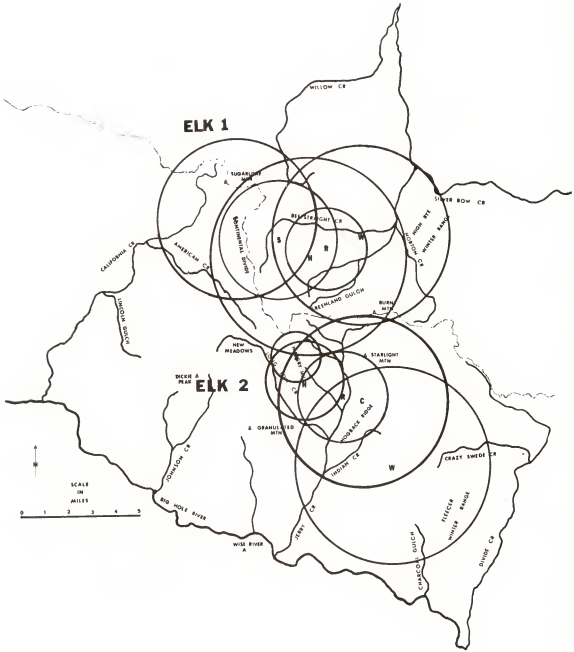
With the progression of the study, it is becoming more and more difficult to understand and describe what elk habitat is, especially from the basis of specific biological requirements. As the previous section on home ranges and movements demonstrates, most of elk management unit 319 is elk habitat based on the fact that radioed elk (and other elk) have been found in most of the unit one time or another. The telemetry results have also demonstrated that elk can be highly mobile, semi-nomadic animals and consequently "use" many different vegetative and physiographic combinations. This is also supported by the established foot route system in the study area, where elk sign has been recorded throughout the entire study area in all kinds of situations. Of course, there are habitat and/or cover types that receive more "elk use" than others based on elk sign present, but can it be assumed that elk sign occurrence is an accurate index of both temporal and spatial use and thus importance of a single type? For example, findings to date have indicated that during the summer months wet sedge meadows have had more elk sign recorded in them than was recorded in most timber habitat types; conversely, during the rut and fall months, elk sign increased considerably in all timber types, while elk sign decreased in several park and broken park types (Figs. 24-26). We can probably assume that large differences in elk sign recorded between 2 or more habitat or general cover types reflect real differences in both time spent using them and overall importance, while moderate to small differences may only reflect general movement differences and sampling error. During the rut and fall months, timber in general was used much more than during the summer months and certain timber habitat types appeared to have more elk sign in them than others. Most often, however, these differences were not great (Fig. 26) and it may be largely academic to rank-order these timber habitat types according to elk sign present for the purpose of establishing preference ratings.

A more realistic and predictable approach to define elk use of the timber cover type has been attempted. Each of 5 forest habitat types, comprising over 85 percent of the timber portion of the route system, were divided into 5 density classes of tree regeneration. These five density classes ranged from class 1 = 100 to 250 trees/acre to class 5 = 1,500+ trees/acre. Most of the regeneration was alpine fir and/or whitebark pine and it was assumed that these 5 density classes provided an index of hiding cover quality. This assumption was based on a good relationship found between sight distance (that distance at which approximately 90 percent of an elk is hidden) and regeneration density (Fig. 27). Regeneration was considered to be all trees with a dbh of less than 4 inches; seedlings were not counted.



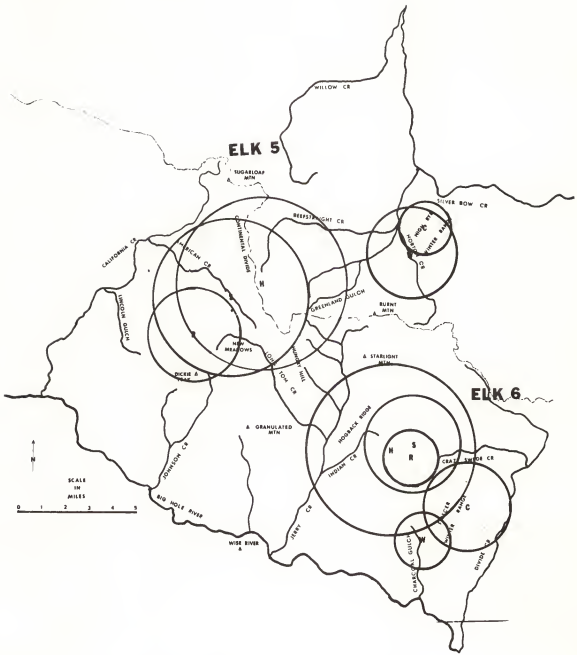
C= calving (May 1 - June 15), S = summer (June 16 - August 31), R= rutting (September 1 - October 15), H= hunting (October 16 - December 5), W=winter (December 6 - April 30).

Figure 16. Seasonal standard diameters and geographic centers for radioed elk 1 in 1975 and radioed elk 2 in 1974 and 1975.



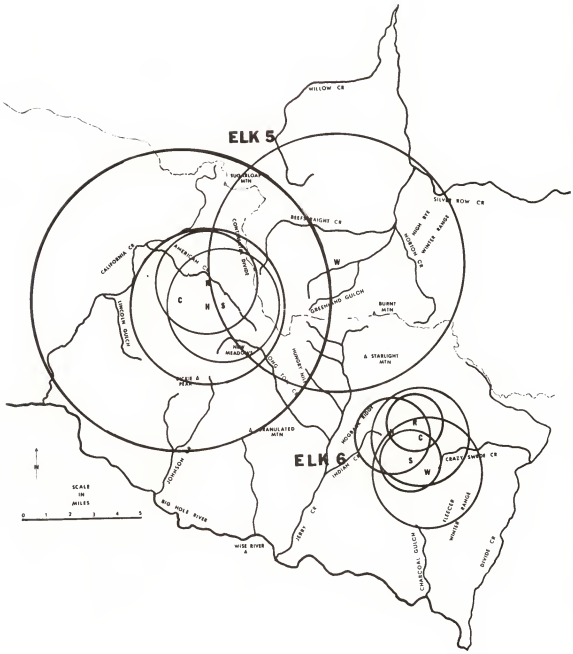
C= calving (May 1 - June 15), S=summer (June 16 - August 31), R= rutting (September 1 - October 15), H=hunting (October 16-December 5), W=winter (December 6 - April 30).

Figure 17. Seasonal standard diameters and geographic activity centers for radioed elk 1 and 2 in 1976.



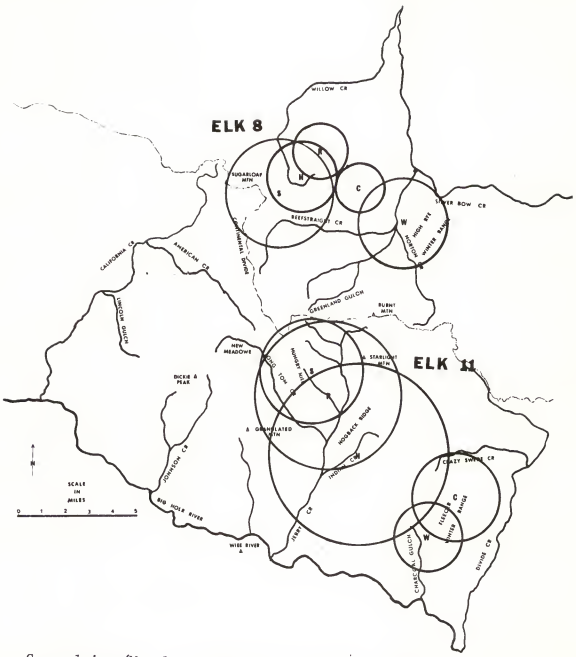
C = calving (May 1 - June 15), S = summer (June 16 - August 31), R = rutting (September 1 - October 15), H = hunting (October 16 - December 5), W = winter (December 6 - April 30).

Figure 18. Seasonal standard diameters and geographic activity centers for radioed elk 5 and 6 in 1975.



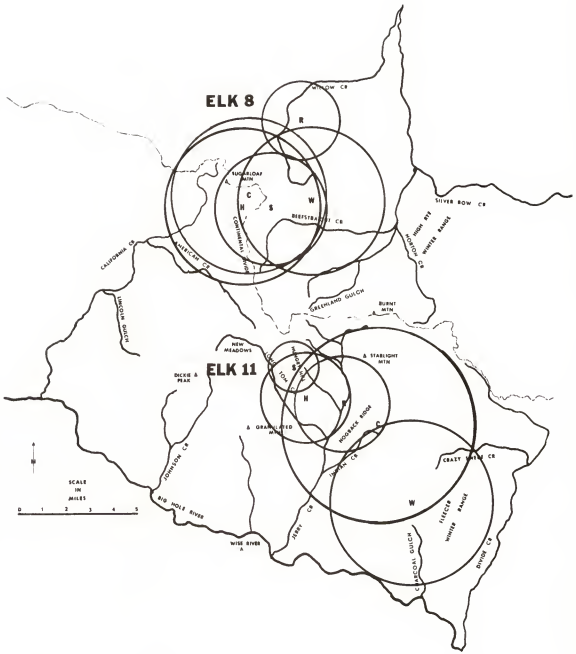
C = calving (May 1 - June 15), S = summer (June 16 - August 31), R = rutting (September 1 - October 15), H = hunting (October 16-December 5), W =winter (December 6 - April 30).

Figure 19. Seasonal standard diameters and geographic activity centers for radioed elk 5 and 6 in 1976.



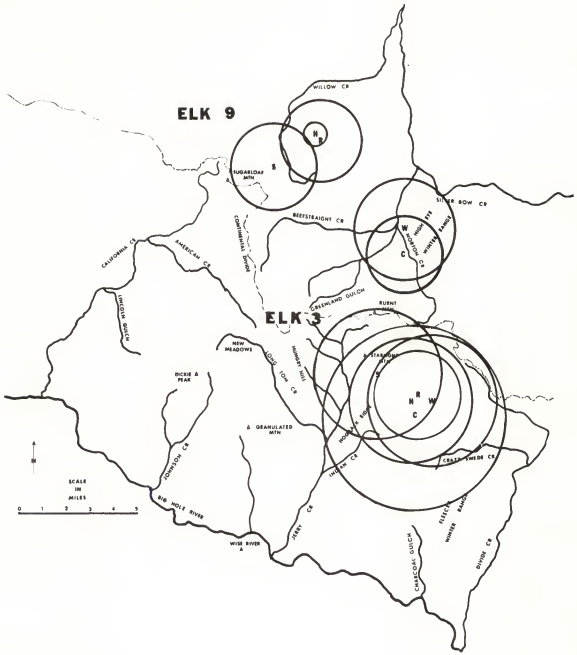
C = calving (May 1 - June 15), S = summer (June 16 - August 31), R = rutting (September 1 - October 15), H = hunting (October 16 - December 5), W = winter (December 6 - April 30).

Figure 20. Standard seasonal diameters and geographic activity centers for radioed elk 8 and 11 in 1975.



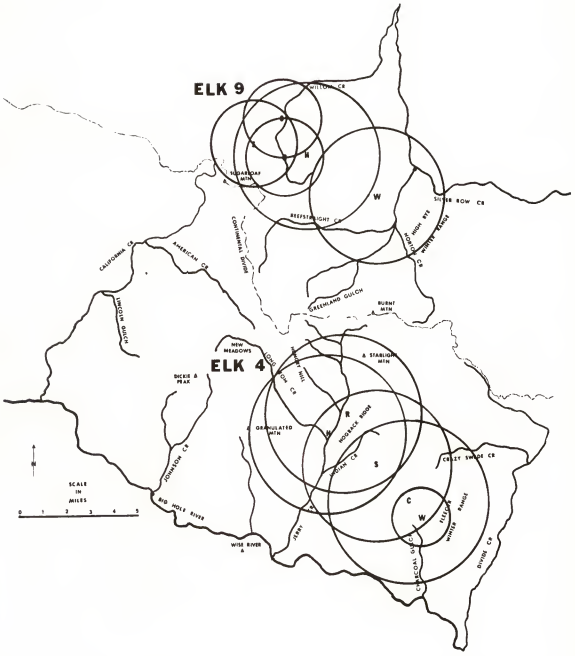
C= calving (May 1 - June 15), S = summer (June 16 - August 31), R = rutting (September 1 - October 15), H = hunting (October 16 - December 5), W = winter (December 6 - April 30).

Figure 21. Standard seasonal diameters and geographic activity centers for radioed elk 8 and 11 in 1976.



C = calving (May 1 - June 15), S = summer (June 16 - August 31), R = rutting (September 1 - October 15), H = hunting (October 16-December 5), W = winter (December 6 - April 30).

Figure 22. Standard seasonal diameters and geographic activity centers for radioed elk 9 in 1975 and radioed elk 3 in 1976.



C= calving (May 1 - June 15), S = summer (June 16 - August 31), R = rutting (September 1 - October 15), H = hunting (October 16 - December 5), W = winter (December 6 - April 30).

Figure 23. Standard seasonal diameters and geographic activity centers for radioed elk 9 and 4 in 1976.

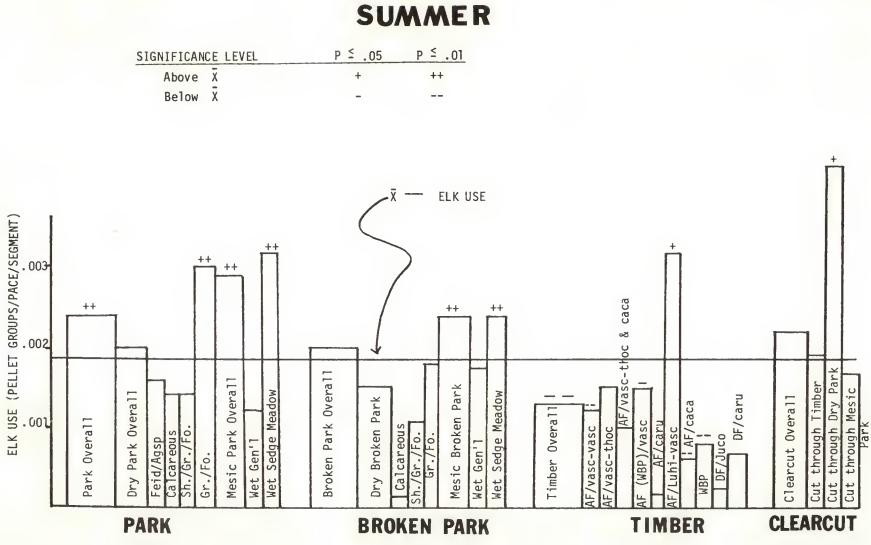


Figure 24. Elk use-habitat and cover type relationships for the summer season, 1973-1976. (Timber habitat types after Pfister, et al. 1977).

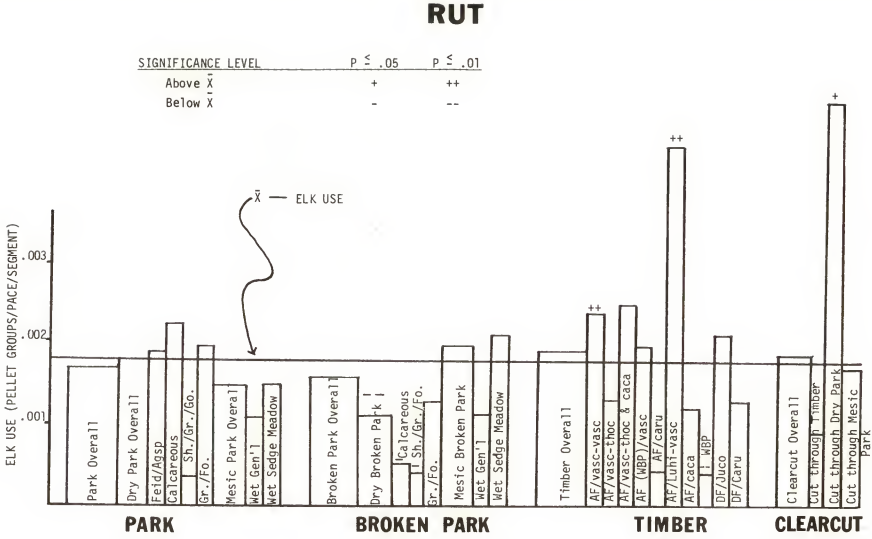


Figure 25. Elk use- habitat and cover type relationships for the rutting season 1972 - 1976.

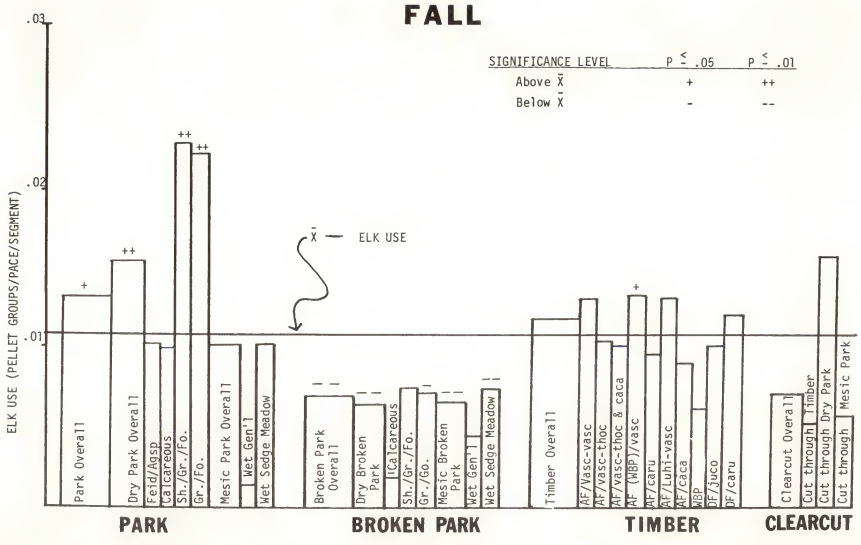


Figure 26. Elk use-habitat and cover type relationships for the entire fall season, 1971-1975.

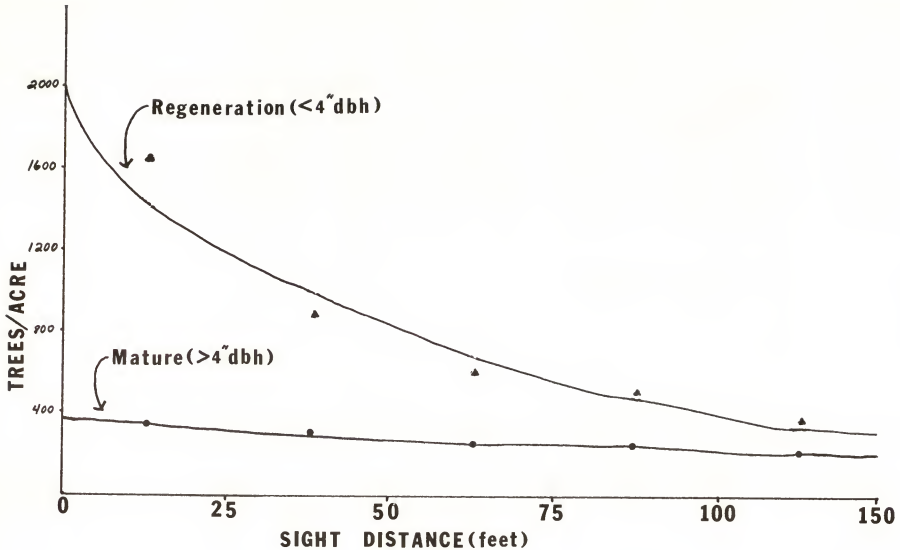


Figure 27. Comparison between sight distances classes and tree density measurements from the timbered segments of the route system in the Long Tom Creek study area.

During the summer months, findings indicate very little selection for any particular density class. Conversely, during the rut and especially during the entire fall, elk use tended to increase as regeneration density increased (Figs. 28-30). This relationship was also noted when elk use between the 5 regeneration density classes was compared disregarding habitat types (Fig. 31).

Each segment of the entire route system has been assigned to 1 of 7 sight distance classes. Intensity of elk use was compared between these 7 classes for the summer, the rut, and the entire fall seasons for all years combined (Fig. 32). For the summer season elk use tended to progressively increase as sight distance increased, which corresponds well with previous findings of high summer elk use in parks and broken parks compared to timbered segments (Fig. 24). Elk use was highest during the rut and fall seasons in the low sight distance categories, least in the middle sight distance categories, with use tending to increase again toward the high sight distance classes (Fig. 32). This relationship strongly implies that high quality foraging sites (bunchgrass parks) adjacent to high security cover (timber) is an important combination for elk during the fall months. This is supported by Figure 26 where the timber and park general cover types had the highest elk use. The use in the middle sight distance classes may have occurred primarily as a result of elk movement between feeding and bedding.

Results from our telemetry work indicated elk tended to use the same general area during both the summer and fall months, while the foot route data showed how elk use changed within these areas between seasons. These findings emphasize the importance of interspersion and combinations of various cover types (including habitat types) that must be present to make good summer and fall "elk habitat". Proximity and condition of winter range and the level and degree of other land uses (hunting, logging, grazing, mining, etc.) are also very important.

The Long Tom Creek Study area has been determined to be composed of approximately 68 percent timber, 21 percent park, 8 percent broken park, and 3 percent clearcut (excluding new cuts as a result of recent logging). Further breakdowns of various types and calculations of indices to describe juxtaposition have only recently been completed on a preliminary basis. A comprehensive analysis using the many intrinsic and extrinsic factors (Table 1) that occur on the Long Tom Creek summer and fall elk range is underway. In this analysis an attempt to determine the various interactions between these factors will be made. Progress of this analysis will be presented in next year's report.

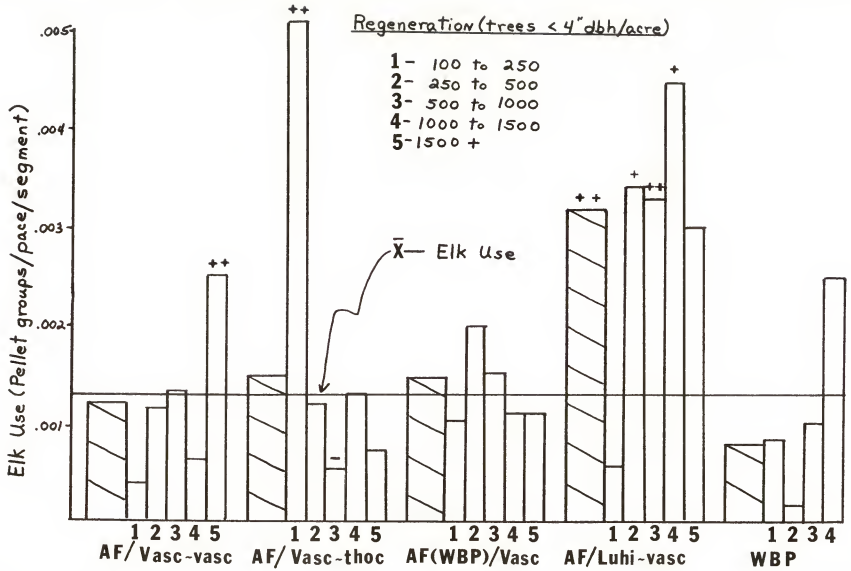


Figure 28. Elk use-cover type relationships within and between 5 forest habitat types for the summer season, 1973 - 1976. (Significance of use above or below the mean is indicated as in Figure 24.)

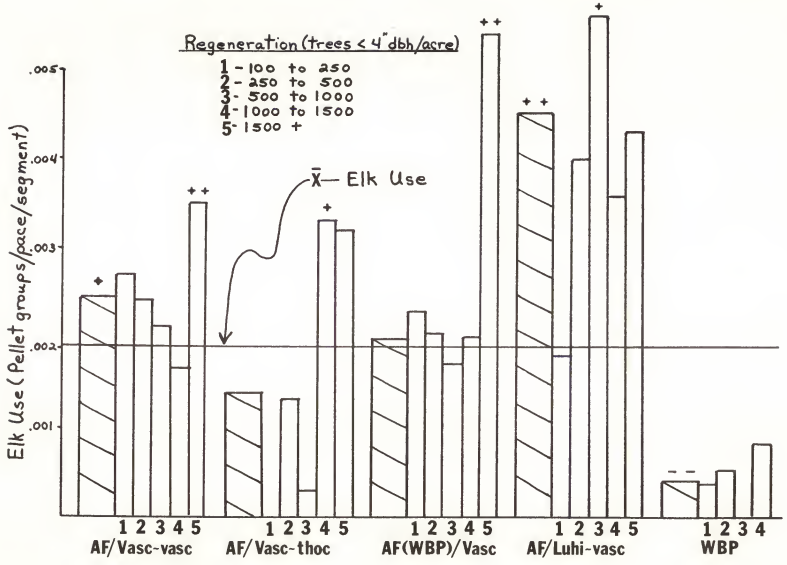


Figure 29. Elk use-cover type relationships within and between 5 forest habitat types for the rutting season, 1972-1976. (Significance of use above or below the mean is indicated as in figure 24.)

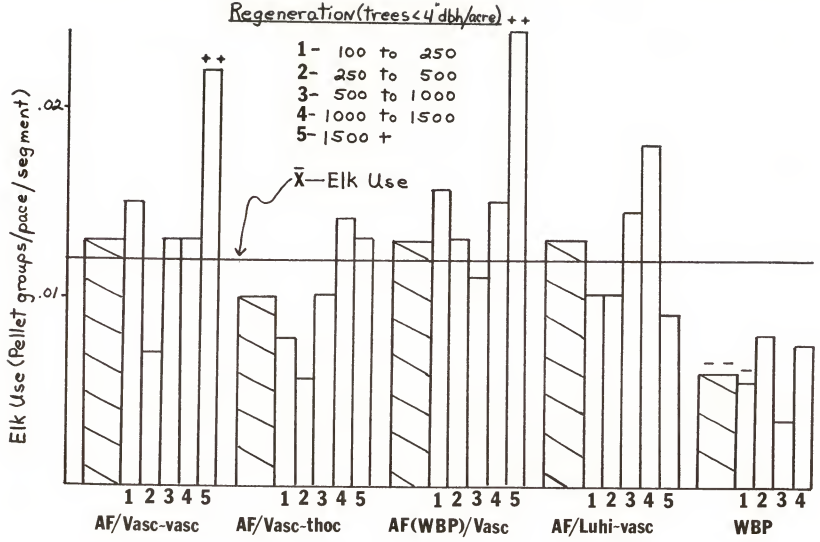


Figure 30. Elk use-cover type relationships within and between 5 forest habitat types for the entire fall season, 1971-1975. (Significance of use above or below the mean is indicated as in figure 24.)

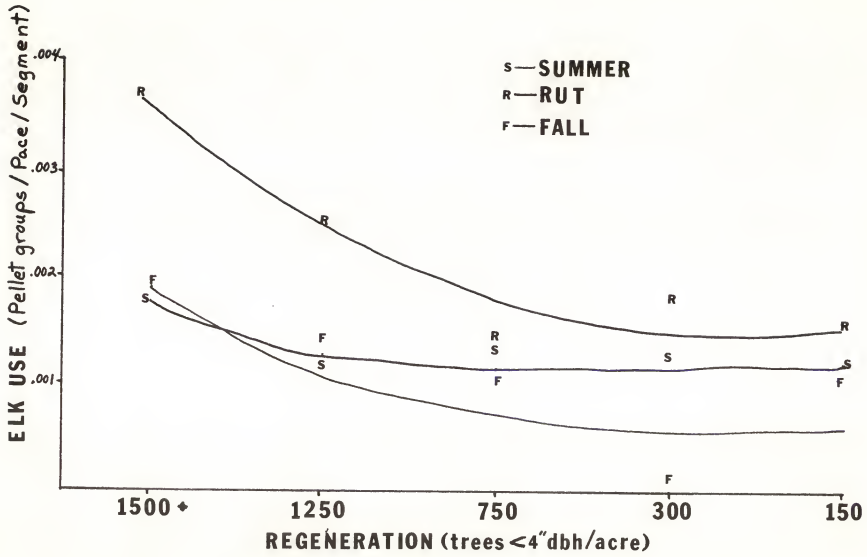


Figure 31. Comparison of seasonal elk use to regeneration density of timber as determined by the foot route system (timbered segments only) in the Long Tom Creek study area during 1972 - 1976.)

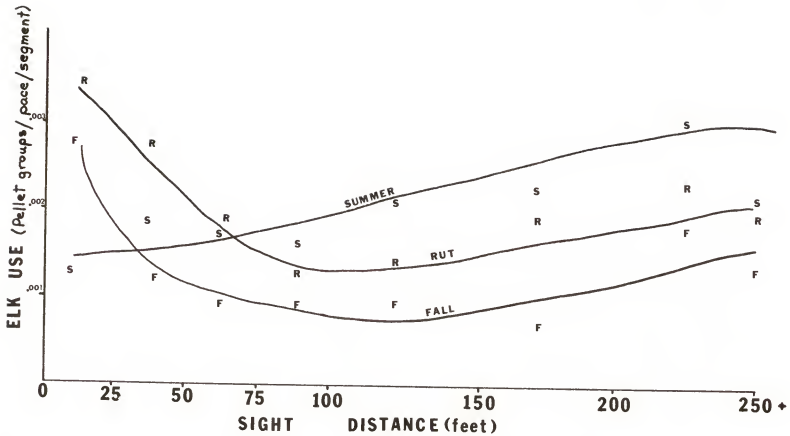


Figure 32. Comparison of seasonal elk use to sight distance as determined by the foot route system (all segments) in the Long Tom Creek study area during 1972 - 1976.

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Lonner, T.N. 1976. Montana Cooperative Elk-logging study. Job II-B, Long Tom Creek Study. pp. 15 - 56. Prog. Rpt. January 1 - December 31, 1975. 81 p.

Pfister, et al. 1977. Forest Habitat Types of Montana, May 1977. USDA Forest Service Gen. Tech. Report, INT-34, 174 p. Intermt. Forest and Range Exp. Station, Ogden, Utah.

Submitted By: Terry N. Lonner

JOB II-C

SAPPHIRE DIVIDE STUDY

FINAL REPORT

INTRODUCTION

The last annual report for this study was completed in July, 1975 and reported work done through 1974. This, the final report, will discuss work done in 1975 and 1976 and in some cases will present results for the duration of the study. Preliminary work began on the study in Spring of 1970 but the formal study began early in 1971 with trapping and radio collaring of seven elk. In the next three years, radios were placed on an additional 21 elk and several were recaptured and reradioed. Radio tagged animals provided the means for studying seasonal and daily movements, habitat use, and elk use of the area in relation to human use. The major emphasis, as in other studies of the Montana Cooperative Elk-Logging Study, was to relate elk use of the area to logging and its associated effects.

Study Area

The Sapphire Mountains extend southward from Missoula, separating the Bitterroot Valley on the west from Rock Creek. Although several radio tagged elk came almost into Missoula during summers, the main study area is approximately 20 miles to the south and all trapping was done on the Threemile Game Range (see Figure 1). Approximately 170 elk wintered on this state game range during the study. The winter range, at 4500 feet elevation, was used by elk from about December 1 to June 1 each year and most elk moved east, to and over the Sapphire Divide, approximately 7,000 feet elevation, during summer and fall.

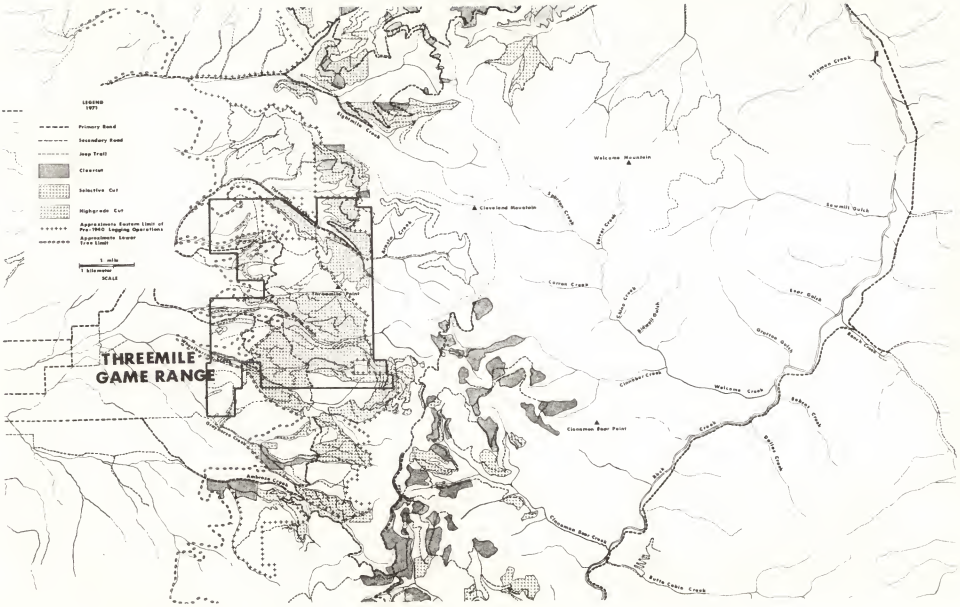

Figure 1: Sapphire Elk Study Area

Logging History and Activity During Study

Nearly all mature forests in the foothills were selectively logged in the 1930's. Much of the area was selectively relogged since the early 1960's. The previous owner of the southern 3,000 acres of the Threemile Game Range retained a 5-year option to log the area. Most of this area was selectively logged in 1972 and 1973, while the elk study was in progress. Figure 1 shows areas logged within and near the study area through 1973.

Most lands east of the foothills, except along Rock Creek, were accessible only by pack or "jeep" trail prior to completion of the Ambrose Creek road to the Sapphire Divide in 1964. Further access to the northwest portion of the area was provided by the Welcome Mountain road in 1965. Clearcutting or partial cutting in blocks was initiated in 1965 and completed by fall of 1971 along or near the Sapphire Divide (Figure 1). Most of this logging was carried out under direction of the U.S. Forest Service on public lands; however, one small area in the head of Wheelbarrow Creek and Spring Gulch, owned by the Burlington Northern Company, was partially cut in the fall of 1971. A logging road was constructed around the head of Threemile Creek in 1973, however no logging other than that involved in clearing a right-of-way for the road occurred that year. This road was closed to public traffic during that fall and logging took place during the 1974 and 1975 field seasons. Some spur roads adjacent to the divide were closed to access during the fall of 1971, and additional ones were closed in 1972 and 1973. Areas to the north and south of the study area shown in Figure 1 have been heavily roaded and logged, mostly prior to 1965.

Dissemination of Results

Eleven publications have been produced thus far from this study, besides the annual reports. Annual reports were distributed widely in professional circles by the Montana Cooperative Elk-Logging Study. Four graduate students did field research for their dissertations during the study. Master's theses were completed by Stehn (1973) on daily movements and activity pattersn of cow elk in summer and fall and by Denton (1973) describing our radio tracking system and its accuracy. Beall (1974) worked on winter habitat selection and use and Marcum (1975) on summer and fall habitat selection and use, both for their Ph.D. dissertations.

Papers were presented at the Western States Elk Workshop and published in its proceedings by Beall (1973), Marcum (1973), and Ream (1973). An article was published in Western Wildlands (Ream, 1974) describing the study and presenting some of its findings. Beall (1975) and Marcum (1975) both presented papers at a National Symposium on Elk and Forestland Management. A study of hunting success and satisfaction was done in the study area and results presented at the North American Wildlife and Natural Resources Conference (Stankey, Lucas, and Ream, 1973).

Numerous talks have been given to various public and professional groups during the course of the study and the study was featured on the Wild Kingdom television program which reaches some 14 million people nationally.

FINDINGS

Radio Location of Elk

The last eight elk radio tagged for the study were captured in February and March, 1974 but most of these were still operational in fall of 1976. A chart showing the complete radio tracking history for all elk in the study is shown in Figure 2. Seven bulls and 21 cows were traced an average of 1.5 years (two summer field seasons) each, and six elk were studied for three field seasons each. Actual radio performance was somewhat better than that since some elk were killed by hunters and others lost collars with radios still functioning. The radio collar from Cow Elk O was recovered in the field after 39 months operation and continued functioning for four more months at the University. She apparently was poached sometime between December, 1974 and May, 1975.

Table 1 summarizes ages, length of record, and aerial locations of each bull elk during the entire study, and Table 2 presents the same for cows. Nearly 1800 aerial locations were obtained during the study, representing 470 elk-months of data collection, most during the summer and fall months. The difference in visual observations between bulls and cows should be noted. Bulls were visually spotted 33% of the time while cows were seen 10% more or 43% of the time. Bulls generally were in more rugged terrain and thicker vegetation than cows and were seldom in the company of another radioed elk. They were more consistent in terms of individual variation, with a low of 23% visual observations for bull elk X and a high of 46% for bull elk A4. Cows exhibited much greater variability in their visibility from the air. Cow Elk A, M and T crossed Rock Creek in 1971, 1972, and 1973 respectively and occupied steep, densely timbered slopes, affording visual sightings 13, 24, and 25% of the time. They were often alone or with

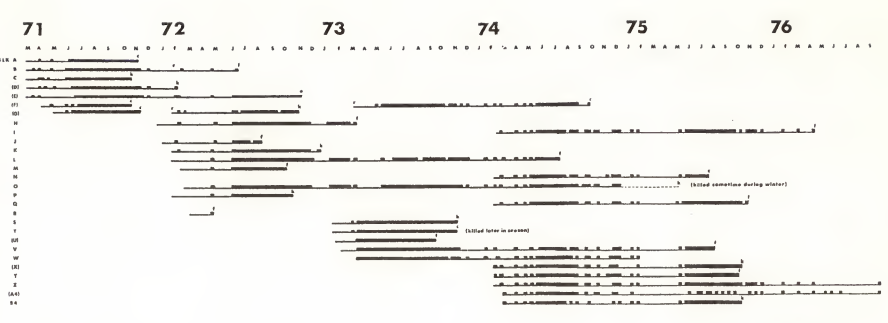

Figure 2:
HISTORIES OF RADIOED ELK

few others. By contrast, Cow Elk H, K, and P usually travelled in large cow-calf groups, were west of the divide on more open slopes during much of the summer, and were seen 72, 62, and 70% of the time respectively.

TABLE 1

MALE ELK RADIO TAGGED

Elk	Age When Collared	# Aerial Locations	% Visual Locations	Length of Record (Months)	Ave. Age While Radioed
D	2.8	49	25	9	3.0
E	2.8	99	33	21	3.7
F	7.9	128	33	27	9.6
G	3.9	86	42	15	4.7
U	1.6	54	24	8	1.9
X	1.7	61	23	20	2.5
A4	1.7	46	46	30+	3.0
Average	3.2	74.7	32.6	18.6	4.1

TABLE 2

FEMALE ELK RADIO TAGGED

Elk	Age When Collared	# Aerial Locations	% Visual Locations	Length of Record (Months)	Ave. Age While Radioed
A	3.8	46	13	11	4.3
B	3.8	62	26	17	4.5
C	5.8	49	41	8	6.1
H	2.5	57	72	5	2.7
I	3.7	67	51	26	4.8
J	2.6	17	59	7	2.9
K	8.6	60	62	10	9.0
L	4.6	124	56	29	5.8
M	5.7	33	24	8	6.0
N	3.7	43	42	18	4.5
O	4.7	139	32	34	6.1
P	4.6	46	70	8	4.9
Q	5.7	59	42	20	6.5
R	3.7	1	100	2	3.8
S	3.6	64	45	9	4.0
T	4.6	44	25	8	4.9
V	8.7	114	38	29	9.9
W	10.8	72	32	21	11.7
Y	5.7	57	40	20	6.5
Z	3.7	71	48	30	5.0
B4	8.8	48	52	20	9.6
Average	5.2	60.6	42.7	16.2	5.9

Trapping and Tag Returns

A total of sixty-two individual elk were trapped between March, 1970 and March, 1974, including forty-seven cows and fifteen bulls (Table 3). Through 1976 we had tag returns on thirty-six (58%) of the elk trapped; of these, thirty-one were known hunter kills, one was poached, and four were found dead in the area, probably of natural mortality, although gunshot wounds may have been responsible for two. Eighteen of twenty-eight radio tagged elk died in this time period, fifteen as known hunter kills and one poached. In addition, there were fourteen instances of recapture and handling of the sixty-two individuals, some re-radioed. Only one elk died from handling, apparently from a massive heart failure.

TABLE 3

TRAPPING AND TAG RETURNS

	Radio Tagged Elk			All Trapped Elk		
	Trapped	Tag Returns	%	Trapped	Tag Returns	%
Female	21	13	61.9	47	25	53.2
Male	7	5	71.4	15	11	73.3
Total	28	18	64.3	62	36	57.7

Elk Movements

Maps showing movements, summer ranges, and patterns of use were presented in the 1972, 1973, and 1974 annual reports of the Montana Cooperative Elk-Logging Study. At least for purposes of discussion and description there appear to be four types of seasonal movements:

1. Limited Seasonal Movement.

   A number of elk, particularly cows with calves, stay around the winter game range into early summer and slowly move up in elevation to the divide. In moist summers this may occur in late July or August, although it is a very gradual movement. The summer range is characteristically very small, 5-10 square miles and elk were rarely more than 5 miles from the winter range.

2. Early Longer Movement and Limited Summer Movement.

   Some elk, both cows and some bulls, leave the winter range in late May or early June, travel 8-12 miles, and then establish a more restricted summer range. Cow elk A, M and T all crossed Rock Creek in early summer (about 10 miles) and then set up a very limited (4-5 square mile) summer range. Cows exhibiting this type of seasonal pattern appeared to travel to their summer range area before dropping calves. Elk F, an old, well-established bull, in each of three separate years, crossed the divide and went into the more rugged portions of Welcome Creek where he remained, at least until the rut.

3. Variable Summer Movements.

   Some elk, particularly bulls, appear to be much less restricted in their summer movements. They often travel early, stay in one

area a few weeks and move on to another area, seemingly lacking a central area of activity. Cow elk O appeared to exhibit this pattern more so than any others. Early each summer, for three years, she left the winter range and moved north almost to Missoula, where she dropped a calf and gradually moved south again along the Sapphire Divide, spending time in various drainages. Bulls, particularly young ones, exhibited less restricted summer ranges than cows and from August to October traveled about a lot, sometimes 8-10 miles within a few days.

4. Dispersal Movements.

One radio-tagged, two-year old bull (A4) left the Threemile Game Range area in June, 1974 and traveled north, almost to Missoula, and in two days crossed railroad tracks, Interstate 90, the Clark Fork River, and old U.S. Highway 10 near East Missoula, ending up in the Rattlesnake Mountain Range and in fall in the Jocko River drainage 20 miles north of Missoula. He has remained in the Jocko and Rattlesnake Range area ever since, spending the last three winters in the Jocko drainage. Although this was the only radioed elk in our study to disperse from the study area, several other studies have shown similar disperal movements.

Elk Habitat Selection and Use

Research was done on both winter and summer habitat selection and use. Elk are more restricted on their winter range, are more subject to meteorologic extremes, and only a limited number of habitat types are available for use, thus winter studies were focused on microhabitats and differences between habitats used, forage preferences, and man-made

modifications of habitat (Marcum, 1975). Summers of 1972, 1974, and 1976 were relatively moist summers while 1973 and 1975 were hot, dry summers. The summaries below of winter and summer-fall habitat selection and use are taken from Beall (1974) and Marcum (1975), both Ph.D. dissertations done as part of this study. Copies of both were distributed to all cooperators on the Montana Cooperative Elk-logging Study and to the Forests and Districts involved.

1. Winter Habitat Selection and Use (Beall, 1974).

Pellet group surveys to evaluate distribution and physiographic type utilization reveal that elk spend 43 percent of their time on south exposure slopes, 21 percent in open grassland feedings areas, 18 percent on north exposure slopes, and 17 percent on ridge tops. In addition, they spend 61 to 75 percent of the time on the upper one-third of the slopes.

Elk movements and habitat selection were affected by snow depths. In each winter of the study, snow depth were appreciably different. The areas of primary elk activity shifted up or down-slope depending on the amount of snow present. The lowest elevation occupation period was in 1972, which was a deep snow year. The highest elevation occupation period was in 1973, which was a record dry year for western Montana. When snow depths approached 18 inches elk began moving lower to areas of lesser snow depth. This does not imply that elk are unable to travel in snow depths in excess of 18 inches, for elk were observed to travel through snow depths in excess of 3 feet. However, the energy expenditure apparently is such, particularly with a crust, that the animals are reluctant to travel through

deep snow.

Elk do react to changing ambient air temperature and radiation conditions. Under various meteorological conditions, elk appeared to "seek out" rather specific bedding sites. During unseasonably warm, humid periods, elk movement was reduced to a minimum. Bedding sites were normally on north slopes in dense timber stands. During January, February, and March, elk are in full winter coat, and a logical explanation is that the weather was too warm for "comfort". The animal would have difficulty dissipating the excess heat generated by muscle activity, and the best solution would be to stay in a cool environment and restrict muscular activity.

Maximum movement was observed during periods of extremely cold clear weather. The need for more heat would be conducive to muscular activity. In addition, elk bedded in direct sunlight on open south slopes during these periods, and on north timbered slopes at night where protection from the clear cold sky would be the greatest. During these same periods, elk were frequently observed feeding in the evenings on open south slopes in direct sunlight. As the sun went down, and the shadows moved up slope, elk were observed to move up with them, thus staying in direct sunlight. When shadows completely covered the slope, animals dispersed, and appeared to feed at random.

During ambient temperature conditions between zero and 35^{o}F, a normal pattern would be that daytime bedding sites are located in dense timber stands on ridge tops with a slight north aspect.

Travel to feeding areas was normally 2-3 miles, with feeding periods at dusk and dawn. Nighttime bed sites were generally on open timbered south slopes, and if the feeding area was in a level open field, elk would bed within the feeding area. Night bed sites appeared to be selected for proximity to the feeding site, rather than protection from the cold.

A majority (86 percent) of bed sites evaluated were associated with dense timber clumps on the upper one-third of a slope. During colder periods, elk tended to bed on the south side of the stands during the day, and the north side at night. In warmer periods, elk tended to bed on the north side during the day, and the south side at night. If ambient radiation conditions are used rather than temperature, the regression coefficient values are considerably higher, indicating that thermal and solar radiations are important components of the elk's winter environment.

In addition to bedding within a timber stand, elk have a tendency to bed near an individual tree within the stand. The tree selected appears to be the largest tree available to elk in the immediate vicinity of the bedding site. Similarly, the position near the tree changes with changing temperature and radiation. During warm temperature ranges, elk tend to bed on the north side of trees during the day, and the south side at night. During cold ranges, the reverse is true. When radiation values are considered, the regression coefficients are again higher than the temperature coefficients.

Initiation of logging activity caused an initial avoidance

response by elk. However, elk appeared to become conditioned to logging activity and after 14 to 21 days resumed normal activity.

Altering of elk habitat by logging activity creates an adverse ecological situation which is avoided by elk for long periods of time. Areas logged on the Game Range received light to medium use in winters prior to the logging. In the winter following logging, no use was made of these areas. Choice bedding sites were removed or severely altered, and movement was restricted because of large amounts of slash. Because of the after effects of logging, more use was made of areas outside the Game Range boundary than in prior years.

Timber harvest is not recommended on an existing well used elk winter range. Animals can be expected to avoid recently logged areas because of the drastic habitat change. It is conceivable that a limited use winter range can be improved by logging. However, operations must be under strict environmental and ecological controls, with the primary emphasis placed on animal habitat, rather than timber production.

2. Summer-Fall Habitat Selection and Use (Marcum 1975).

Under prevailing conditions, elk used several habitat factors significantly in excess of the availability of those factors. Habitat conditions generally selected for by elk from June through November for the entire study period were identified as (1)Pseudotsuga menziesii/Calamagrostis rubescens (DF/Caru) and Abies lasiocarpa/Galium triflorum (AF/Gatr) habitat types, and less importantly, because of low elk use and availability,

the riparian and shrub-graminoid plant communities; (2) slopes on southwest and south aspects; (3) gentle (0-15^{0}) slopes; (4) drainage bottoms and upper slopes; (5) elevations of 5,350 to 6,349 feet from an available range of 3,850 to 7,900 feet; (6) an overstory canopy coverage of 26-75% percent; and (7) areas within 150 yards of water. Also, when in openings, elk selected for areas near timber. However, during each year of the study, environmental situations selected for by elk regardless of between-year variations were (1) the Abies lasiocarpa/Galium triflourm (AF/Gatr) habitat type, (2) drainage bottoms and upper slopes, (3) gentle (0-15^{0}) slopes, (4) elevations of 5,850 to 6,349 feet, and (5) areas within 50 yards of water. The Pseudotsuga menziesii/Xerophyllum tenax (DF/Xete), Abies lasiocarpa/Menziesia ferruginea (AF/Mefe, and Abies lasiocarpa/Xerophyllum tenax (AF/Xete) habitat types were most important, respectively, in terms of total elk use, but were not selected for. Also, moderately steep (16-30^{0}) slopes were most used, but total use did not exceed availability.

Elk preferred to feed in Abies lasiocarpa/Galium triflorum (AF/Gatr) and Pseudotsuga menziesii/Calamagrostis rubescens (DF/Caru) habitat types, on southwest aspects, on midslopes and drainage bottoms, on steep (30^{0}) slopes, and within areas with 25 percent or less overstory canopy coverage except for clearcuts. Elk preferred to bed in Abies lasiocarpa/Menziesia ferruginea (AF/Mefe) and Abies lasiocarpa/Xerophyllum tenax (AF/Xete) habitat types, on north and northwest aspect slopes, on upper

slopes and ridges, and within areas with greater than 75 percent overstory canopy coverage.

Substantial between-year and seasonal differences in habitat use and, in some cases, selection by elk were attributed to direct or indirect influences of weather. During 1971, spring moisture was near normal, bu the summer was hot and dry. Spring precipitation was much higher than normal during 1972, and early summer weather was moderated by cool-moist periods. 1973 was a drought year, and the summer was hot. During 1972, desiccation of plants was delayed, and all elk made greater use of relatively xeric plant communities, warm aspects, and areas with less than 25 percent overstory canopy coverage. Conversely more mesic or hydric plant communities, cool aspects, and areas with greater than 25 percent overstory canopy coverage received less elk use during 1972. These relationships were reversed during the relatively warm, dry years of 1971 and 1973. Habitat use during the drought year of 1973 differed from habitat use during 1971 and 1972 mainly in that areas near water, and lower slopes received greater elk use in the summer of 1973.

Open system roads and areas within 550 yards of open system roads were selected against by elk, the use of open spur and four-wheel drive trails did not differ significantly from availability, and closed roads were selected for. However, when open spur roads and four-wheel drive trails, and roads closed to four-wheeled vehicles were considered, elk selected against areas near roads only during 1971, the year of most intensive logging activity in

the study area. Cows used areas on or near roads more than bulls did. Both sexes were found closer to roads during June, July, and November than during other months. The greatest use of lands 1 mile or more from the nearest open road occurred during October, the month when the general hunting season opened.

During autumn, elk were more often found near open roads and in open timber stands when hunting seasons were closed than when they were open. Much of the displacement of elk from open roads during hunting seasons was in excess of 1 mile. Moderately timbered areas were used about the same by elk in autumn during hunting seasons and when hunting season were closed. However, use of heavily timbered areas increased substantially during hunting seasons.

Clearcuts were selected against by elk throughout the study. Use of partially cut areas was not significantly different from their availability during 1971. However, partial cuts were selected for during 1972 and 1973. Elk tended to select against areas near clearcuts during 1971 and 1972, but not during 1973, when logging activity within the area was lowest. When all logged areas (clearcuts and partial cuts) were considered, areas in close proximity to cuts were selected against by elk only during the year of most intensive logging activity, 1971. Cows were found in close proximity to logged areas more often than bulls were. Bull elk were located on or near logged areas most often during June and November. Cows used such areas to the greatest extent during June and July, and during October and November.

Elk were displaced during summer and fall months by road building and logging when those activities occurred at higher elevations in major drainages. The animals were less disturbed in summer by logging which was initiated during the early spring at lower elevations on the winter range area, where the terrain was relatively gentle. Potential detrimental effects of road building and logging activities on elk can be mitigated by confining those activities to as small an area as possible during a given time period, and closing adjacent roaded drainages to traffic.

Elk avoided human activity, not the roads. Roading and logging an area, to the extent that these activities were carried out within the study area, will not long preclude normal levels of summer-fall elk use, except on the clearcuts themselves, when intensities of human activities are low. However, the use of such areas by elk can be further enhanced, even during hunting seasons, by closure of the roads to vehicular traffic. There also may be a biological justification for road closure, to prevent the possibility of an overharvest of that portion of the elk herd which ranges in closer proximity to roaded areas.

No measurable benefits accrued to elk within the study area as a result of clearcut logging. Elk were more tolerant of logged areas in which only a portion of the timber stand was removed; however, cuttings of this type above the winter range areas did not contribute to the welfare of the elk herd. Conversely, since the pregnancy rate was high and the herd was increasing in numbers

there is no evidence that logging to date above the winter range was harmful in terms of elk productivity. Since the length of the hunting season is adjusted yearly to prevent a substantial overharvest of the elk herd, logged and roaded areas probably had a greater influence on the style, quality, and opportunity of hunting than they did on the welfare of the elk herd. However, rapid removal of the overstory from large areas could conceivably alter future conditions for elk, and may adversely affect productivity, especially if the elk continue to select against clearcuts. If continual deforestation eventually does alter summer-fall habitat adversely, road closures alone may not provide enough protection for elk in the future. Therefore as logging continues, care should be taken to insure that cover as well as forage needs of elk are met throughout the enitre cutting cycle. Also, continuing studies should be carried out to define the rate at which logging can proceed without adverse effects on elk.

Biological and physical habitat situation which are consistently selected for by elk, and which appear to have the greatest potential for influencing herd productivity should remain unaltered where possible. Areas near water, such as drainages and drainage heads, coinciding especially with early to mid-seral stages of the Abies lasiocarpa/Galium triflorum (AF/Gatr) habitat type, and with the Abies lasiocarpa/Menziesia ferruginea (AF/Mefe) habitat type in some places, fall into this category. Also, it may be desirable to exclude from these situations within the high elevation forest zone in unroaded or closed areas. Elk make such wide use

of the environmental situations available to them that the welfare of the herd cannot be disregarded on any substantial portion of the summer-fall range by land managers while formulating land use plans for an area. This being the case, land and wildlife managers should strive to protect critical areas, as previously described, and insure a juxtaposition of other environmental situations which are selected for or heavily used by elk, including moderate to dense timber stands on various aspects, on gentle (0-15^{0}) to moderately (16-30^{0}) steep slopes, on upper slopes, and within the major forested plant communities on the area. Other factors being equal, selectively logged areas will be more readily accepted by elk than clearcuts, and since elk exhibited a significant preference for remaining within 100 yards of timber stands when in open areas, clearcut openings probably should not be too large. Also, logged areas should be isolated from open system roads, and such roads should be located away from streams as far as possible to avoid excessive disturbance of elk.

DISCUSSION

The 1976 annual progress report of the Montana Cooperative Elk-Logging Study presents 8 recommendations for the consideration of land managers. There is some evidence from the Sapphire Divide Study that would support each of the 8 recommendations:

1. Displacement of radio-tagged elk during road building and logging was observed on several sale areas, indicating a need for security areas.
2. Marcum's (1975) work indicated that moist sites at the heads of drainages are important to elk, particularly in hot, dry summers.
3. Elk movement patterns as determined by radio locations has indicated that low saddles and game trails should be avoided, where possible, when designing and locating road systems.
4. Although limited in data on this study, we have observed that radio-tagged elk appear to move away from portions of their summer range when cattle are moved into those portions, indicating a need for recognizing this problem when opening areas to cattle use.
5. Work by both Beall (1974) and Marcum (1975) has shown that structure of plant communities may be more important in some cases than composition or habitat type.
6. Use of clearcuts by radio-tagged elk was minimal, less than would be expected based on area involved, thus indicating that clearcuts are not beneficial. Neither can they be considered detrimental however, since the total population is stable or growing slowly.
7. Timber harvest is not recommended on important well used elk winter ranges. This recommendation was based on data of Beall's

(1974) which showed that elk on winter range prefer dense timber stands and larger trees for bedding cover.

8. The road closure recommendation is supported by several facets of this study. Stankey, Lucas, and Ream (1973) found that hunting success and satisfaction were both greater for hunters who got away from open roads. Movements of radio-tagged elk during hunting season indicated that elk rapidly learned to avoid open roads and seek out the least disturbed portions of the study area.

For a complete description of these recommendations and the findings supporting each, please see the 1976 annual progress report of the Montana Cooperative Elk-Logging Study. Copies of the recommendations may also be obtained from the State Fish and Game Department or Region 1, U.S. Forest Service.

Finally in the Sapphire Study Area we obtained data during (1971) and after the Sapphire Sale, before (1971-73) and during the Arasta Sale in Threemile Creek, and before and after several small sales on and above the Threemile Game Range. This provided several opportunities to observe the relationships between elk, logging, and roads. From the data collected as a result we conclude that road building and logging activity tend to move elk out of the area of activity to more secure areas. After logging activity has ceased, human activity on road systems may have the same effect. When roads are closed, elk will gradually assume use of the logged and roaded areas, although use of clearcuts appears to be minimal. Hunting success and satisfaction appear to be greater for hunters using unroaded portions of the area.

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Submitted By: Robert Ream

JOB II-D

CHAMBERLAIN CREEK STUDY

Progress Report for the Period January 1 - December 31, 1976

INTRODUCTION

Briefly, the major object of this study is to describe elk distribution, and elk use of several available environmental factors before, during, and after logging. The study has been conducted by personnel of the School of Forestry, University of Montana under contract to the Bureau of Land Management since 1975. However, because of inadvertent delays during 1975 in transfer of responsibility for the study, this progress report represents the first presentation by us of results from a complete field season. We received additional funding for the study during the report period from the McIntire-Stennis Federal Forestry Program administered through the School of Forestry, University of Montana.

A graduate student, Mike Scott, joined the project in June 1976 and will study elk habitat selection and use during the pre-disturbance phase. It was anticipated last year that logging would begin within Chamberlain Creek no later than the spring of 1978. However, because of delays associated with construction of the contract road into the area, logging will probably not begin until the fall of 1978 or the spring of 1979. This will enable us to complete two full field seasons, without road building or logging disturbance occurring within the study area.

Generally, we feel that 1976 has been a very productive year for the Chamberlain Creek Study. All diagonal pellet transects are installed, all transect segments have been described, an initial pellet survey on all transects is complete, most initial vegetative sampling on proposed cutting blocks is complete, several supplemental pellet transects have been installed on proposed cutting blocks, and three elk traps have been erected on winter ranges adjacent to the study area. In addition, the 1976 data have been transferred to computer cards, and although time limitations prevented a complete treatment of these data for this report, computer programs have been written which will permit a variety of analyses.

Study Area

The study area (Figure 1) is located in the main fork of Chamberlain Creek, 45 miles east of Missoula in Powell County Montana. The area is approximately 5,772 acres in size of which 3,983 (69%) are National Resource Lands (BLM) and 1,789 acres (31%) are Burlington Northern Inc. lands. Major drainages surrounding the study area are the East Fork of Chamberlain Creek, Pearson Creek, and Wales Creek to the east; the North

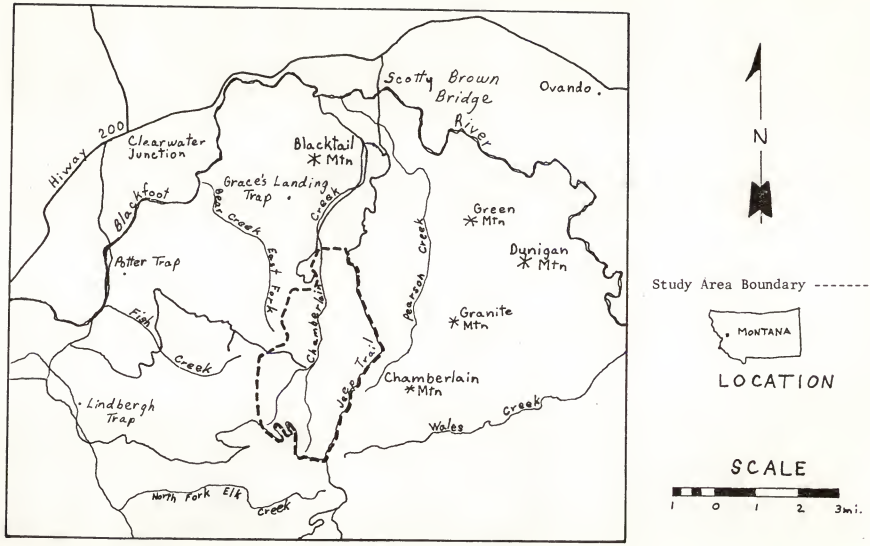

Figure 1. Chamberlain Creek study area.

Fork of Elk Creek and Cap Wallace Gulch to the south; and the East Fork of Bear Creek, Fish Creek, and Little Fish Creek to the west.

Most of the study area is heavily forested. There are wet meadows and two clearcuts in upper Chamberlain Creek, and several open sidehill parks on the northern part of the study area, but these comprise only a small portion of the total unit. The forested area is made up of a variety of habitat types, all within the Douglas-fir (Pseudotsuga menziesii) or subalpine fir (Abies lasiocarpa) climax series of Pfister et al. (1977). At present, much of the forested land is dominated by seral stands of lodgepole pine (Pinus contorta). Topographically, the area is moderate to gentle, although a few steep rocky slopes occur adjacent to the lower stretches of Chamberlain Creek. Elevations range from 4,400 feet in the creek bottom at the north end of the study area to 6,800 feet on the southeast side of the drainage.

Access to the periphery of the study area is good, with logging roads approaching the north and south ends, and a "jeep" trail forming the southeast and eastern boundaries. One "jeep" trail penetrates the center of the area from the west boundary. All of these roads are closed to unauthorized vehicular access between 1 September and 1 December.

METHODS

Habitat Description

A total of approximately 35 miles of permanent belt transects four feet wide have been established diagonally across the study area from northeast to southwest at approximately 1/4 mile intervals. Each transect has been broken into segments by cover type and/or habitat type. The vegetative and topographic characteristics of each segment were described as follows:

Transect Segment Length - Each segment is measured in steps. All segments have a minimum length of 50 feet and a maximum length of 1/8 mile.

Cover Type - A three digit expression of the amount of vegetative canopy cover in the low shrub (up to 1.5 feet tall), shrub (1.5 to 4.5 feet), and tree canopy. The code used for each digit is:

1 - Canopy cover less than 5%
2 - Canopy cover 5% to 33 1/3%
3 - Canopy cover 33 1/3% to 66 2/3%
4 - Canopy cover greater than 66 2/3%

Habitat Type - Habitat typing is according to Pfister et al. (1977).

d.b.h. Code - A three digit code describes the tree density in each of three size classes; greater than 8 inches dbh, 4-8 inches dbh, and less than 4 inches dbh. The code for each digit is:

1 - Not present
2 - Less than 30 stems per acre
3 - 30 to 150 stems per acre
4 - More than 150 stems per acre

Understory Type - A code describing the two most abundant plants, their canopy cover, and the total understory vegetative cover.

Sight Distance - A single digit expressing the distance at which an adult elk would be completely hidden from a standing observer. The code for the distance is:

1 - Less than 25 yards
2 - 25 to 50 yards
3 - 50 to 75 yards
4 - 75 to 100 yards
5 - 100 to 125 yards
6 - Greater than 125 yards

Deadfall - A three digit code in which the first two digits represent the percentage of ground surface covered by deadfall and the last digit represents the average depth of deadfall to the nearest foot.

Successional Stage - A single digit code, primarily based on climax trees, expressing the relative stage of plant community maturity. The successional code (after Thomas et al. 1976) is:

1 - Grass-forb
2 - Brush-seedling (only forbs, shrubs, and tree seedlings occupy the site)
3 - Pole-sapling (small trees)
4 - Young (dense stand of tall trees, usually seral species)
5 - Mature (seral trees mature or overmature, and climax trees well developed as an understory)
6 - Old (climax trees mature and dominant, may be some seral trees remaining)

Elevation - The height to the nearest 100 ft. of the midpoint of a transect segment.

Aspect - The azimuth of the transect segment in degrees.

Slope - The slope of the transect segment measured in degrees.

Topography - A two digit code expressing the land form of the segment.

1 - Creek bottom
2 - Lower slope
3 - Mid-slope
4 - Upper slope
5 - Ridgetop
6 - Dry bench
7 - Swale
8 - Flat
9 - Wet meadow
10 - Wet bench

Distance to Water - The distance, to the nearest 100 yards, from the center of each transect segment to the nearest water.

Distance to Road - Same as above for any road on which it is possible to drive a 4-wheel vehicle. Open and closed roads will be treated separately.

Distance to Non-road Disturbance - Same as above, primarily for different types of cutting units.

Summaries of these transect segment descriptions by length provide the estimates for availability of environmental components within the study area.

Elk Data

The basic data on elk use is derived from pellet counts on each transect segment. Also, the study area was divided into subunits based on topography and vegetative homogeneity to describe animal distribution. Transects were surveyed once last year (summer 1976), but in future years they will be surveyed twice per year. Pellet groups of elk (also deer and moose) were recorded, and each group was classified according to age via the method described by Lyon (1973a). The age categories are:

Fresh - still warm, slimy, etc.
New - mostly brown, only minor weathering
Old - gray to brown, weathered
Very Old - gray, weathered, checked, falling apart

Supplemental transects have been installed on proposed cutting units which were not covered by the diagonal transects. To provide information on yearly variations in the time of elk movement to summer ranges, additional transects will also be installed on higher elevations of winter ranges outside the Chamberlain Creek core study area. These

transects will be surveyed periodically during the spring for fresh pellet groups only. Yearly population changes will be assessed by counting elk during periodic winter and spring flights over the area. We will attempt to estimate elk population size using a modified capture-recapture technique (Schnabel's Multiple Census Method 1938, as modified by Chapman 1952) involving the aerial and ground observation of marked versus unmarked animals.

Three corral traps have been erected on adjacent winter ranges, and we have captured and marked elk during the last two winters. Data from aerial and ground locations of radio-collared elk will be used to study elk distribution, movements, and some aspects of habitat use both inside the core study area and on larger surrounding areas where there are no pellet transects.

Changes in Plant Communities

Permanent vegetation plots located in proposed representative cutting blocks will be measured before logging, immediately after logging, and every other year thereafter for the duration of the study. A sampling technique using a series of nested plots along two 25 meter transects (Lyon 1973b) will be used. This technique is also being used in the other investigations of the Montana Cooperative Elk-Logging Study, which will facilitate the comparison of results from different areas.

Relative Hunter Use and Elk Harvest

Information on hunter use, and elk harvest within the study area will be obtained from the Montana Fish and Game Department check station at Bonner, Montana.

Data Summarization and Analysis

All data have been transferred from field sheets to computer cards, and computer programs have been written to obtain data summaries in terms of elk use of the environmental variables noted previously. The data were analyzed by testing for significant differences between elk use of specific environmental situations and the availability of those situations within the study area using the z test of significance of a binomial proportion (Snedecor and Cochran 1967). The following convention was used in reporting the significance between parameters being compared: + or - indicates elk use was significantly greater or less than availability, $p \leq 0.05$; ++ or -- indicates use was significantly greater or less than availability, $p \leq 0.01$; () indicates that $p \leq 0.10$ and $p > 0.05$; and the lack of a sign indicates no significant difference.

As mentioned in the methods section, each pellet group recorded was categorized in one of four age groups: Fresh (F), New (N), Old (O),

or Very Old ((VO). This allows us to examine elk use as related to availability of the 14 habitat components in a number of possible combinations. We obtained initial computer summaries for FN, O, VO, OVO, and FNOVO pellet groupings, and for this report have decided to use the FN (sample size = 201) and OVO (sample size = 1,068) combinations. Because of time limitations, habitat components were examined only as single independent variables with elk utilization this year. Since the pellet survey for 1976 was conducted between August 17 and September 1, the FN combination appears to represent mostly July-August elk use. The OVO combination represents elk use prior to July, including carryover pellets from previous years. Lyon (1973a) analyzed elk pellet group deterioration rates in western Montana and concluded that there was no obvious consistency in the location of carryover pellet groups. Thus, it appears that the OVO class summary is an approximation of total elk use on the area for one year or more prior to the spring of 1976. Also, by examining the number of pellet groups on potential winter range within the study area, we estimate that 5 percent or less of the total elk use occurred during winter months. We will improve our ability during 1977 to describe seasonal elk use by increasing the pellet surveys to two runs, and by clearing pellet groups from the transects or painting the pellets with tree marking paint during each run. This will also eliminate any problems we might encounter in the future in detecting changes in elk distribution as a result of carryover pellet groups.

FINDINGS AND DISCUSSION

Elk Distribution

To describe elk distribution, the study area was divided into subunits (Figure 2) based on topographic and vegetative homogeneity. Since only one pellet survey was made last year, little can be said concerning seasonal variations in distribution. However, the data presented in Table 1 show substantial differences in the selection of subunits by elk during summer (F & N) when compared to total use (O & VO). During the summer of 1976 only subunit 3 was used significantly in excess of its availability, while for total use (O & VO) units 1 and 8 were used significantly in excess of availability. Subunits 1, 5 and 11 were used significantly less than their availability during summer, as were subunits 2, 4, 5, 6, 7 and 11 for total use. Regardless of elk habitat selection, units 8, 9 and 11 combined received more than 50% of the use for both time periods. These results appear to be most strongly related to seasonal habitat preferences for forage, cover, etc., as opposed to other factors such as human disturbance.

Vegetative Factors

The total use pattern was one of selection for the more xeric habitat types (Table 2). Use was greater than availability for all the

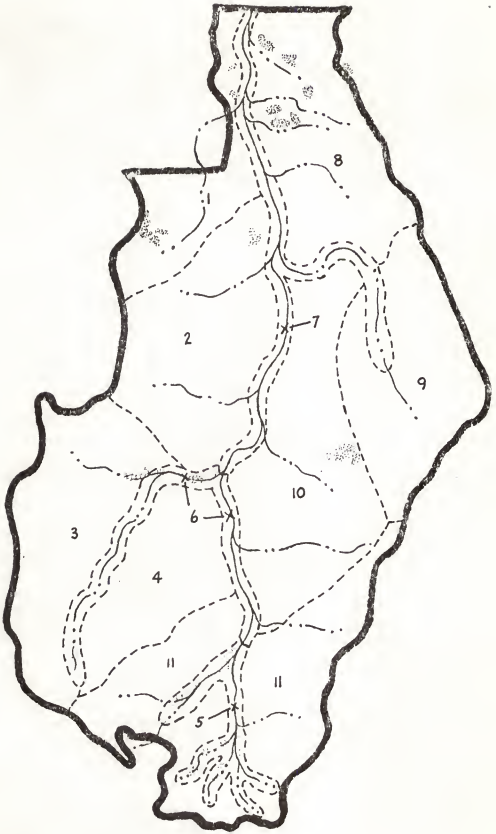

Figure 2. Subunits of the Chamberlain Creek study area.

Table 1. Elk use by subunit in the Chamberlain Creek study area - 1976.

Subunits	% Availability	% Elk Use	
		Fresh & New	Old & Very Old
1	8.8	-5.5	++11.5
2	9.5	10.9	--5.9
3	9.0	+14.4	8.5
4	6.4	7.0	-4.9
5	2.5	--0.5	--0.3
6	2.3	3.0	--0.7
7	1.8	1.0	--0.3
8	15.6	19.4	++29.9
9	14.8	17.9	15.3
10	15.8	19.4	15.6
11	13.5	--1.0	--7.1

Table 2. Elk use by habitat type or phase (Pfister et al. 1977) in the Chamberlain Creek study area - 1976.

	% Availability	% Elk Use	
		Fresh & New	Old & Very Old
Pseudotsuga menziesii/Festuca idahoensis	2.5	--0.5	++7.8
Pseudotsuga menziesii/Physocarpus malvaceus[1]	0.6	(-)0.0	0.8
Pseudotsuga menziesii/Vaccinium globulare-Xerophyllum tenax[2]	1.3	-0.0	1.5
Pseudotsuga menziesii/Linnaea borealis[3]	1.1	2.0	1.3
Pseudotsuga menziesii/Symphoricarpos albus[4]	0.9	0.5	+1.7
Pseudotsuga menziesii/Calamagrostis rubescens-Agropyron spicatum	1.6	1.0	++5.2
Pseudotsuga menziesii/Calamagrostis rubescens[5]	4.7	5.0	++6.8
Abies lasiocarpa/Clintonia uniflora	1.0	1.0	0.9
Abies lasiocarpa/Calamagrostis canadensis	3.7	5.5	3.4
Abies lasiocarpa/Calamagrostis canadensis-Galium triflorum[6]	4.1	4.0	--1.3
Abies lasiocarpa/Linnaea borealis	1.9	--0.5	-1.1
Abies lasiocarpa/Linnaea borealis-Xerophyllum tenax	14.6	17.4	16.3
Abies lasiocarpa/Menziesia ferruginea[7]	25.0	24.8	--18.6
Abies lasiocarpa/Xerophyllum tenax-Vaccinium globulare[8]	25.9	28.8	-23.0
Abies lasiocarpa/Xerophyllum tenax-Vaccinium scoparium	4.9	5.5	4.3
Abies lasiocarpa/Alnus sinuata	4.0	3.0	(-)3.0
ROCK	0.2	0.0	0.0
CLEARCUT	2.0	--0.5	(+)3.0

1 Includes PSME/PHMA-CARU
2 Includes PSME/VAGL and PSME/VAGL-XETE
3 Includes PSME/LIBO-SYAL, PSME/LIBO-VAGL, and PSME/LIBO-CARU
4 Includes PSME/SYAL-AGSP, and PSME/SYAL-CARU
5 Includes ABLA/CARU
6 Includes ABLA/GATR, ABLA/VACA, and ABLA/CACA-VACA
7 Includes ABLA/CLUN-MEFE, and ABLA/CLUN-ARNU
8 Includes ABLA/VAGL and ABAL/XETE-VAGL

Pseudotsuga menziesii types, significantly greater for Pseudotsuga menziesii/Festuca idahoensis, Symphoricarpos albus, Calamagrostis rubescens, and Calamagrostis rubescens - Agropyron spicatum. With one exception total use was lower than availability for the Abies lasiocarpa habitat types. The Abies lasiocarpa/Calamagrostis canadensis - Galium triflorum habitat type occurs primarily on the main creek bottoms and reflects the significantly lower pellet counts in these areas. Both summer and total use was significantly lower than availability on the Abies lasiocarpa/Linnaea borealis type. An examination of the data from these segments reveals a low sight distance and/or high deadfall levels, both of which receive significantly lower elk use. Although total use was significantly lower than availability for the Abies lasiocarpa/Menziesia ferruginea and Abies lasiocarpa/Xerophyllum tenax - Vaccinium globulare types, these two together comprised 42% of the total use. The summer use pattern for the habitat types tended to be somewhat the opposite of the total use pattern. Summer use on the Pseudotsuga menziesii habitat types was generally lower than availability while use of the Abies lasiocarpa habitat types was very similar to their availability. As with total use, three habitat types (Abies lasiocarpa/Linnaea borealis - Xerophyllum tenax, Abies lasiocarpa/Menziesia ferruginea, and Abies lasiocarpa/Xerophyllum tenax - Vaccinium globulare) accounted for the majority (70%) of summer use. Total elk use of clearcuts was significantly higher than availability while summer use was significantly lower. This may indicate a tendency to use the clearcuts primarily in the early spring and possibly in the fall.

All elk use was significantly lower than availability for sight distances (Table 3) of less than 50 yards. For sight distances greater than 50 yards, use is at least equal to availability. Total use is significantly higher than availability at sight distances greater than 100 yards.

Summer use is concentrated in the 50 to 75 yard category, which is used significantly more than its availability. This may not indicate a selection for this sight distance so much as a combination of other factors. Multiple factor analysis in the future will probably lead to a clearer interpretation of the results. The moderate sight distances (50-100 yards) comprise 58% of the area and receive 70% of the summer use and 58% of the total use.

The total use and summer use patterns are almost completely opposite with regard to successional stage (Table 3), indicating strong seasonal changes in use patterns. The shrub-seedling stage represents the clearcuts discussed earlier. The pole-sapling stage is characterized by a dense stand of small (<4" dbh) trees, the young stages represent somewhat more open stands of medium-sized lodgepole pine (Pinus contorta), mature stages represent stands of larger lodgepole and young Abies lasiocarpa, and the old stages are usually characterized by large Abies lasiocarpa or Pseudotsuga menziesii.

Table 3. Elk use by sight distance, successional stage, and deadfall in the Chamberlain Creek study area - 1976.

	% Availability	% Elk Use	
		Fresh & New	Old & Very Old
Sight Distance			
<25 yards	5.7	--2.0	--3.2
25-50 yards	27.3	-20.9	--19.2
50-75 yards	44.0	++56.2	44.2
75-100 yards	13.9	13.9	14.2
100-125 yards	4.4	4.0	++10.3
>125 yards	4.7	3.0	++8.9
Successional Stage			
Grass-forb	-	-	-
Shrub-seedling	1.8	--0.5	+3.0
Pole-sapling	3.3	2.5	--1.2
Young	43.7	++56.2	--36.9
Mature	26.0	24.9	27.1
Old	25.2	--15.9	++31.8
Dead Fall			
<10% cover, <1.5 feet deep	43.3	42.3	(+)46.2
<10% cover, >1.5 feet deep	6.0	(+)10.0	++9.0
10-30% cover, <1.5 feet deep	24.3	21.4	--20.9
10-30% cover, >1.5 feet deep	13.5	15.4	+16.4
>30% cover, <1.5 feet deep	5.8	6.4	--3.1
>30% cover, >1.5 feet deep	7.1	(-)4.5	--4.4

There appears to be a tendency to select for middle-age stands in the summer and older stands and clearcuts in other seasons. Again, this effect is likely the result of a combination of factors.

In general, areas with less than 30% of the ground surface covered by deadfall (Table 3) are used in proportions greater than their availability while areas with more than 30% are used less than their availability. An exception to this is the 10-30%, $<$1.5 ft. category, where summer use is low and total use is significantly lower than availability. The primary effect of deadfall on elk use appears to be determined more by the amount of area covered by deadfall than by the depth of the deadfall.

Because of uncertainties in categorizing the cover type, understory type, and tree density data, this information will not be presented until the next progress report.

Topographic Factors

Elk distribution with respect to slope, aspect, elevation, and topography is shown in Tables 4 and 5. For the summer period (F & N) elk selected moderate (10-19^{0}) slopes, west aspects, and mid-slopes. No positive selection was shown for elevation. This is not particularly surprising considering that the topographic relief within the study area is not great when compared to many other Rocky Mountain elk ranges. Generally, the topographic characteristics selected by elk during summer also received the greatest percentage use. Steeper slopes; southeast aspects; low elevations (4,500-5,000 ft.); and upper slopes, ridgetops, and wet benches were used significantly less than availability by elk. These results are consistent with known patterns of elk use of topographic factors on summer ranges, especially so when considering the relatively mild weather conditions in the area during the summer of 1976. During hotter and drier summers, we would expect greater use of protected exposurers as well as creek bottoms and other wet areas.

Considering total use (O & VO) of the study area, elk selected moderate (10-19^{0}) to moderately steep (20-29^{0}) slopes, northwest aspects, low (4,500-5,000 ft.) to moderate (5,100-5,600 ft.) elevations, and ridgetops and swales. Slopes and aspects which were selected by elk were also most heavily used. However, the 5,700-6,200 ft. elevation category received the greatest percentage use by elk, even though it was used significantly less than availability. Similarly, the mid-slopes received the greatest elk use of any topographic category, even though they were not selected by elk in terms of total use. This is probably inevitable considering the overwhelming availability of mid-slopes. Total elk use was significantly less than availability on 0 to 9^{0} slopes; northeast, southeast, and south aspects; moderately high (5,700-6,200 ft.) and high (6,300-6,800 ft.) elevations; and lower slopes, flats, wet meadows, and creek bottoms.

Table 4. Elk use by slope, aspect, and elevation in the Chamberlain Creek study area - 1976.

	% Availability	% Elk Use	
		Fresh & New	Old & Very Old
Slope			
<5°	10.1	8.5	--7.0
5-9°	22.9	21.9	--15.7
10-19°	44.5	++55.2	++52.4
20-29°	17.2	(-)12.9	(+)19.2
30-39°	5.3	--1.5	5.7
Aspect*			
North	5.7	8.5	5.8
Northeast	16.6	16.9	(-)13.7
East	8.1	8.0	7.1
Southeast	4.7	--2.0	(-)3.6
South	1.7	2.0	--0.6
Southwest	12.8	12.4	14.2
West	15.2	+20.9	16.4
Northwest	15.9	15.4	+18.5
Elevation			
4,500 - 5,000 ft.	9.3	--4.0	++12.4
5,100 - 5,600 ft.	22.7	27.4	++28.6
5,700 - 6,200 ft.	49.9	52.7	--44.7
6,300 - 6,800 ft.	18.1	15.9	--14.3

* Excludes ridgetops, stream bottoms, and segments with a slope of less than 5°.

Table 5. Elk use by topography in the Chamberlain Creek study area - 1976.

Topography	% Availability	% Elk Use	
		Fresh & New	Old & Very Old
Lower Slope	7.7	6.5	--4.4
Mid-Slope	59.7	(+)66.1	59.1
Upper Slope	8.8	-5.0	9.1
Ridgetop	7.9	-4.5	++14.2
Dry Bench	2.1	2.5	2.4
Swale	2.2	2.0	++4.8
Flat	6.1	8.4	--4.2
Wet Bench	0.6	(-)0.0	0.4
Wet Meadow	0.9	1.0	--0.3
Creek Bottom	4.0	4.0	--1.1

Differences between summer and total use infer major changes in the use of topographic habitat components by Chamberlain Creek elk during different seasons. Future data collections at more frequent intervals will lead to a better understanding of these seasonal differences.

Distance to Water

Elk pellet distribution as related to distance to water is shown in Table 6. During summer there was no significant difference between this distribution and availability of distances of from 0 to 450 yards from water. This is the result one would expect considering the mobility of elk, the mild weather during the summer of 1976, and the obvious fact that there are few places within the study area that are more than 450 yards from water. However, the percentage of fresh and new pellet groups counted within the 450-850 yard interval was significantly less than the percentage area available within that interval. Results for total use are more difficult to interpret, but appear to represent both a tendency for elk to avoid areas more than 450 yards from water during summer months, and to avoid lower slopes and creek bottoms at other seasons.

Distance to Road and Non-road Disturbance

Pellet distributions generally appear to indicate an avoidance by elk of road and non-road disturbance (clearcuts or seed tree cuts). For summer use, when vehicular traffic is greatest, this relationship is significant only within 50 yards of roads. For total elk use this result is significant to 250 yards from the nearest road, which may indicate a response by elk to roads during the hunting season. Even though the roads are closed to vehicles then, hunters probably enter the area along roads, and may spend much of their time on or near roads. In light of the results of elk use in relation to roads, where human activity probably is greatest, the results for non-road disturbance are difficult to interpret. They can reflect the reaction of elk to human disturbance only in a small way, and thus must largely indicate selection by elk of other habitat components.

Trapping and Radiotelemetry

Ten elk were trapped and ear-tagged during the winter of 1976: 8 adult females, 1 female calf, and 1 male calf. Seven adult females were fitted with radio-collars. All of these animals were captured at a trap site approximately 1 mile south of the Scotty Brown Bridge (Figure 1).

Several ground approximations and 40 aerial locations were obtained from the radio-tagged elk between 27 May 1976, and 21 November 1976. Nearly all of these locations were in the Green Mountain and Dunigan Mountain areas northeast of the study area. No locations were obtained

Table 6. Elk use by distance to water, road, and non-road disturbance in the Chamberlain Creek study area - 1976.

	% Availability	% Elk Use	
		Fresh & New	Old & Very Old
Distance to Water			
0-50 yards	18.2	18.9	--10.2
50-150 yards	24.1	22.9	++29.7
150-250 yards	21.1	22.4	++24.6
250-350 yards	15.4	16.9	16.6
350-450 yards	11.5	13.9	(+)13.5
450-850 yards	9.7	--5.0	--5.4
Distance to Road			
0-50 yards	3.2	--0.5	-2.3
50-150 yards	9.1	7.5	--5.5
150-250 yards	6.2	7.0	--3.2
250-350 yards	7.2	8.0	7.1
350-450 yards	7.1	7.0	++10.2
450-850 yards	26.4	24.3	+29.3
850-1350 yards	29.8	34.3	(+)32.2
>1350 yards	11.0	11.4	10.2
Distance to Non-road Disturbance			
0-50 yards	3.3	3.0	3.8
50-150 yards	2.6	-1.0	--1.4
150-250 yards	2.6	--0.0	2.7
250-350 yards	2.1	2.5	2.0
350-450 yards	1.8	1.0	1.8
450-850 yards	12.8	--5.0	++18.3
850-1350 yards	17.2	13.9	+20.1
>1350 yards	57.6	++73.6	--49.9

within the Chamberlain Creek core study area, therefore the Scotty Brown Trap was moved to Grace's Landing (Figure 1) in December 1976. Another corral trap was erected at Potter's Ranch (Figure 1). Including the Lindbergh Trap (Figure 1), we now have three corral traps on winter ranges adjacent to the study area.

Nine adult female elk were trapped and radio-collared this winter (1977), 5 at the Lindbergh Trap and 4 at the Grace's Landing Trap. As of 20 June 1977, 7 of these elk have been located within the Chamberlain Creek study area, so we are optimistic that our radiotelemetry studies will be much more productive during 1977 than they were during 1976.

Vegetative Plots and Supplemental Transects

Eleven permanent sets of nested vegetation plots along paired 25 meter transects (after Lyon (1973b) were established on 10 different proposed cutting units with the intent of monitoring changes in vegetation structure and composition related to logging activity. The data from the initial reading of these plots is prepared for analysis. However, minor changes in cut boundaries may force the relocation of some plots. Therefore the results will not be presented until the next progress report.

Three supplemental pellet transects were located and read on proposed cutting units not covered by the original transects. Again, changes in cut boundaries may alter the location of the supplemental transects so this data will not be presented in this report.

Relative Hunter Use and Elk Harvest

The Chamberlain Creek study area is within Hunting District 292. It is also in the Blackfoot Special Management Unit, where roads are closed to vehicular access from 1 September through 1 December.

Information concerning hunter use and elk harvest in the Blackfoot River area was obtained by the Montana Fish and Game Department, Region 2 at the Bonner check station. Hunter use in the Blackfoot declined slightly from 3,844 in 1975 to 3,597 in 1976. However, primarily because of a lack of tracking snow during the 1976 hunting season, the number of elk checked at the Bonner station declined from 233 in 1975 to 95 in 1976. Of the six hunting districts in the Blackfoot unit, only Hunting District 292 exhibited an increased harvest (from 11 to 21 elk) in 1976 compared to 1975.

Sex-age composition of the harvest from Hunting District 292 for 1976 indicates 68 percent adult males, 23 percent adult females, and 9 percent young. The young to adult female ratio was 40:100. This data is no doubt strongly influenced by the fact that Hunting District 292

is open to general hunting of antlered males, but only 50 cow permits are given. We hope to get better and more specific information on hunter use and elk harvest in the study area in future years, by asking hunters at the Bonner check station whether or not they hunted within the Blackfoot Special Management Area.

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Submitted by: C. Les Marcum
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JOBS III - A-1 AND A-2

ROAD CLOSURE STUDIES

The manuscript for the final report has been submitted for publication.

JOB III - B

ELK USE OF DISTURBED AREAS

This segment of the study has been completed and findings were reported in previous progress reports.

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